

EXHIBIT D

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I used the Human Behavior and Deception Detection paper since it gave me the most clues quickly, the other papers I found interesting and informative in my quick glance



“You can’t kid a kidder”: association between production and detection of deception in an interactive deception task

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Both the ability to deceive others, and the ability to detect deception, has long been proposed to confer an evolutionary advantage. Deception detection has been studied extensively, and the finding that typical individuals fare little better than chance in detecting deception is one of the more robust in the behavioral sciences. Surprisingly, little research has examined individual differences in lie production ability. As a consequence, as far as we are aware, no previous study has investigated whether there exists an association between the ability to lie successfully and the ability to detect lies. Furthermore, only a minority of studies have examined deception as it naturally occurs; in a social, interactive setting. The present study, therefore, explored the relationship between these two facets of deceptive behavior by employing a novel competitive interactive deception task (DecelIT). For the first time, signal detection theory (SDT) was used to measure performance in both the detection and production of deception. A significant relationship was found between the deception-related abilities; those who could accurately detect a lie were able to produce statements that others found difficult to classify as deceptive or truthful. Furthermore, neither ability was related to measures of intelligence or emotional ability. We, therefore, suggest the existence of an underlying deception-general ability that varies across individuals.

Keywords: deception, deception detection, lying, signal detection theory, social cognition

INTRODUCTION

It is not uncommon to hear of “poachers turned gamekeepers”; originally this referred to situations in which those who stole livestock from rich landowners would later become employed by the same landowner to guard their livestock. A more modern example relates to the case of the infamous confidence-trickster, Frank Abagnale Jr., who is now an FBI financial fraud consultant. Those who employ former “poachers” assume that people who are good at breaking the law are good at detecting when others break the law. This assumption is widespread, but at least in the case of deception, there is no scientific evidence to suggest that good liars are necessarily good lie detectors.

Although the existence of a “deception-general ability” (confering success in both lie production and detection) has not been explored in the behavioral sciences, it has been suggested that skill in both the production and detection of deception offers selective advantages in human and non-human animals, and, therefore, that each is subject to evolutionary pressure (Dawkins and Krebs, 1979; Bond and Robinson, 1988). Twin studies, in which monozygotic and dizygotic twins are compared on a characteristic of interest in order to isolate genetic and environmental contributions to that trait, provide evidence for the role of evolution in shaping at least the propensity to deceive (with heritability values of between 0.34 and 0.63; Martin and Eysenck, 1976; Young et al., 1980; Martin and Jardine, 1986; Rowe, 1986), if not the ability to do so successfully. Evolutionary biologists and comparative

psychologists have characterized the relationship between deception production and detection as two sides of an intra- or inter-specific “evolutionary arms race”—improvements in the ability to deceive in one species, or in certain members of a species, prompt resultant improvements in deception detection among competitors and vice versa (Dawkins and Krebs, 1979; Bond and Robinson, 1988; Byrne, 1996). While this characterization of the relationship between the ability to deceive and to detect deception is intuitively appealing, it relies on there being an opportunity for evolution to act independently on the two processes, i.e., it assumes that the two abilities depend on different psychological and neurological mechanisms. Interestingly, models of both the production and detection of deception derived from cognitive psychology and cognitive neuroscience do not readily support such a distinction. They posit roles for theory of mind (the ability to represent one’s own and another’s mental states) and executive function processes (conflict monitoring, response inhibition) in both deception production and deception detection (e.g., Spence et al., 2004; Sip et al., 2008). If these models are correct, then selection pressure favoring improvement in either production or detection will result in concomitant improvements in the other ability. One may, therefore, expect that good liars will also be good lie detectors.

In two wide-ranging reviews of the psychological literature on deception by Bond and DePaulo (2006, 2008) it was argued that the over-whelming majority of studies show that humans are poor

lie detectors (achieving approximately 54% lie-truth detection accuracy), and that stable individual differences in lie detection ability may not exist. The latter conclusion was based on a meta-analysis demonstrating that variance in lie detection performance across participants was not greater than that expected by chance, and that no individual difference measure has been shown to reliably predict lie detection performance.

While fully endorsing these conclusions based on the existing literature, we make two observations: (1) that the claim of poor, undifferentiated lie detection performance across participants is only valid given the type of paradigms that have previously been used to study deception detection ability (see DePaulo et al., 2003 for an overview of the range of deception procedures employed), and (2) that potentially the most interesting, and theoretically relevant, individual difference measure has not yet been related to lie detection ability—the ability to deceive. This study, therefore, aims to introduce a novel interactive paradigm to assess the ability to produce and to detect deceptive statements, and to determine whether these two abilities are related; that is, to discover whether a deception-general ability exists.

Real-life deception is a dynamic interpersonal process (Buller and Burgoon, 1996), yet less than 9% (Bond and DePaulo, 2006) of previous deception studies have allowed for even moderate degrees of social interaction between those attempting to produce deceptive statements (“Senders”) and those attempting to detect deception (“Receivers”). The potential impact of this lack of interaction is difficult to gauge at this point in time. Assessment of deceptiveness on the basis of videotaped or written statements removes all opportunity for the Receiver to engage in explicitly taught or intuitive questioning techniques designed to make the task of deception detection easier. Furthermore, the number of channels through which (dis)honesty can be both detected and conveyed may be severely limited, with concomitant effects on the performance of both Sender and Receiver. The lack of social interaction is not the only factor that has contributed to the “dubious ecological validity” (O’Sullivan, 2008, 493) of previous deception research, however; further criticism centers on the “low-stakes” (and accompanying lack of motivation/arousal) inherent in an experimental setting (Vrij, 2000). In an attempt to address these criticisms we introduce a novel, fully interactive, group-based competitive deception “game” based on the False-Opinion paradigm (Mehrabian, 1971; Frank and Ekman, 2004); the Deceptive Interaction Task (DeceIT).

The game entails each player competing with the other members of the group to both successfully lie, and to detect the lies of the other players. The paradigm enables free-interaction between participants, and, therefore, requires participants to control both verbal and non-verbal cues when producing deceptive statements. The competitive element of the game (with accompanying high-value prizes) provides motivation when lying and attempting to detect lies, and increases arousal. The motivational effect makes the task of producing deceptive statements harder; increased motivation has previously been reported to result in impaired control of non-verbal deceptive cues when lying (Motivational Impairment Effect, DePaulo and Kirkendol, 1989), and it renders those tasked with detecting deception more sceptical (Porter et al., 2007). Increasing the difficulty of the Senders’ task is likely to

result in easier detection of deception, and thus make individual differences in deception detection more apparent.

The second advantage to this paradigm is that both deception detection and production can be simultaneously evaluated within participants. Curiously, little research has focussed on individual differences relating to lie production success (Vrij et al., 2010), despite meta-analytic results indicating substantial variance in deceptive ability (Bond and DePaulo, 2008) and prevalence studies showing that approximately 50% of lies are told by only 5% of people (Serota et al., 2010). SDT (Green and Swets, 1966; Meissner and Kassin, 2002) has proved useful in characterizing deception detection performance (by providing independent measures of both the ability to discriminate truthful from deceptive statements, and any bias toward judging statements as truthful or deceptive). Here, for the first time, we also apply SDT to characterize deception production performance (to separate the ease with which statements produced by the Sender can be discriminated on the basis of their veracity, and the credibility of the Sender, i.e., how likely their statements are to be perceived as truthful regardless of their veracity).

The deception literature provides a number of markers by which a novel deception paradigm can be validated. For example, deception has been shown to increase feelings of guilt, anxiety, and cognitive load (Caso et al., 2005) and result in longer response latencies when lying than when telling the truth (Walczyk et al., 2003). The 54% lie-truth discrimination accuracy has also been shown to be remarkably robust (Levine, 2010), and thus we would expect to see all of these effects replicated in this study. Our new paradigm (DeceIT) allows us to determine individual differences in the capacity for successful deception and lie detection. Of chief theoretical interest is whether there is a deception-general ability, perhaps due to underlying individual differences in social decoding and encoding skills (Ekman and O’Sullivan, 1991; Frank and Ekman, 1997; Vrij et al., 2010) which would result in an association between lie production and detection abilities.

MATERIALS AND METHODS

PARTICIPANTS

Fifty-one healthy adults (27 female, mean age = 25.35 years, SD = 8.54) with English as a first language participated in the present study. All participants provided informed consent to participate. The local Research Ethics Committee (Department of Psychology, Birkbeck College) granted ethical approval of the study.

PROCEDURE

Participants were recruited to a “Communication Skills” experiment and randomly assigned to nine groups of five participants and one group of six participants, with the constraint that group members were not previously acquainted. Participants were seated in a circle and asked to complete an “Opinion Survey” questionnaire. The questionnaire comprised 10 opinion statements (e.g., “Smoking should be banned in all public places”) to which participants responded “agree” or “disagree.” Responses to the Opinion Survey served as ground truth in the subsequent task (Mehrabian, 1971; Frank and Ekman, 2004). Participants also completed the Toronto Alexithymia Scale (Parker et al., 2001), a measure of the degree to which emotions can be identified

and described in the self, and the Interpersonal Reactivity Index (Davis, 1980), a measure of empathy. These instruments provide self- and other-focussed measures of emotional intelligence (Mayer et al., 1999; Parker et al., 2001). A subset of participants ($n = 31$, 61% of sample) also completed the Wechsler Abbreviated Scale of Intelligence (Wechsler, 1999).

Participants were then informed that they were to take part in a competitive game designed to test their communication skills and that two £50 prizes would be awarded; one to the participant who was rated as most credible across all trials and the other to the participant who was most accurate in their judgments across all trials. Participants were required to make both truthful and dishonest statements relating to their answers on the Opinion Survey, with the objective being to appear as credible as possible regardless of whether they were telling a lie or the truth. Participants played the role of both “Communicator” (Sender) and “Judge” (Receiver), and their role changed randomly on a trial-by-trial basis.

On each trial, the experimenter presented one participant with a cue card, face-down, specifying a topic from the Opinion Survey and an instruction to lie or tell the truth. This indicated to all participants the Sender for the trial. At a verbal instruction to “go,” the participant turned the card, read the instruction, and then spoke for approximately 20s, presenting either their true or false opinion and some supporting argument. A practice trial was conducted for all participants and the experimenter presented a verbatim example response from the piloting phase of the study to illustrate the type of statement required (“I’m in favour of REALITY TV, it’s got to be one of the most important ways you can learn about the world out there and the way people are going to behave; sometimes seeing a bad example is a good way to shock you down the right path and make you think about what you’re doing or going to do”). Following each trial, Senders were required to rate whether they thought they had been successful or unsuccessful in appearing credible. Simultaneously, Receivers rated whether they thought the opinion given by the Sender was true or false. Each participant completed 10 or 20 trials as Sender, half with their true opinion and half with their false opinion. Statistical analysis demonstrated that performance did not vary as a function of the number of statements produced and so this variable is not analysed further. The 50:50 lie-truth ratio was not highlighted to the participants at any stage to prevent strategic responding in either the Sender or Receiver roles. Following the task, participants were asked to rate on a five point Likert scale ranging from “not at all” to “very much” the degree to which they experienced guilt, anxiety, and cognitive load (referred to as “mental demand”) when lying and when telling the truth. Participants were informed of the competitive nature of the task in both the “Sender” and “Receiver” roles, were given an overview of the trial structure (as above), but at no point were explicit instructions given with regards to aspects of behavior that should be attended to during the game, nor potential strategies.

DATA COLLECTION AND ANALYSIS STRATEGY

Performance in the Receiver and Sender roles was analysed using SDT (Green and Swets, 1966) (as described in Figure 1). An advantage of SDT is that it allows lie-truth discriminability (d')

to be measured independently of judgment bias (C). Separate SDT measures were calculated for the Receiver/Sender roles: the Receiver’s capacity to discriminate lies from truths was indexed by d'_{Receiver} ; the corresponding measure of bias, C_{Receiver} , indicates the tendency of a Receiver to endorse a given opinion as truthful (credulity). The discriminability of the Sender’s truths and lies is indexed by d'_{Sender} . The corresponding measure of bias, C_{Sender} , indicates the perceived credibility of a Sender’s opinions, regardless of their veracity. With these measures, better lie detection is indicated by higher d'_{Receiver} values, and increasingly successful deception is indicated by more negative values of d'_{Sender} .

RESULTS

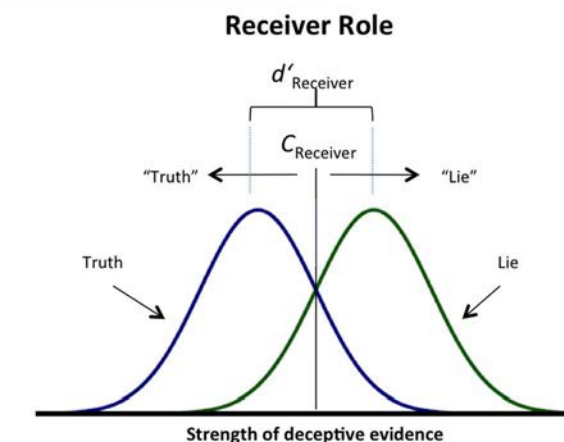
PARADIGM VALIDATION

In line with previous studies (Caso et al., 2005) participants reported greater Guilt, Anxiety, and Cognitive Load when lying than when telling the truth (Guilt $t_{(50)} = 7.060$, $p < 0.001$, $d = 1.226$, Anxiety $t_{(50)} = 9.598$, $p < 0.001$, $d = 1.784$, Cognitive Load $t_{(50)} = 9.177$, $p < 0.001$, $d = 1.421$). Also in common with previous studies (Walczyk et al., 2003), Response Latency was significantly shorter when participants told the truth ($M = 4.6$ s SD = 2.0) than when they lied ($M = 6.5$ s SD = 3.1, $t_{(50)} = -3.885$, $p < 0.001$, $d = 0.728$). Finally, task performance in the Receiver role was analyzed using conventional percentage accuracy rates and overall accuracy was found to be 54.1% (SD = 8.7%), not significantly different to the 54% reported previously (Levine, 2010) ($t_{(50)} = 0.065$, $p = 0.950$, $d = 0.013$) but significantly greater than chance ($t_{(50)} = 3.335$, $p = 0.002$, $d = 0.667$). Fractional rates addressing accuracy for different types of statement showed a significantly lower mean accuracy for truths ($M = 51.1\%$, SD = 11.9%) than for lies ($M = 57.1\%$, SD = 10.5%, $t_{(50)} = -3.731$, $p < 0.001$, $d = 0.746$). To compare any response bias in the Receiver role with findings from the literature, we calculated the number of statements of all types classified by Receivers as truthful and found it to be 46.7% (SD = 8.8%) a figure significantly lower than chance ($t_{(50)} = -2.667$, $p = 0.005$, $d = 0.535$).

INDIVIDUAL DIFFERENCES: SDT ANALYSIS

Large individual differences were observed in all of the four performance measures (M $d'_{\text{Receiver}} = 0.242$, SD = 0.418; M $C_{\text{Receiver}} = -0.086$, SD = 0.233; M $d'_{\text{Sender}} = 0.272$, SD = 0.509; M $C_{\text{Sender}} = 0.097$, SD = 0.256). Of principal interest is the fact that detectability in the Sender role (d'_{Sender}) and the ability to discriminate in the Receiver role (d'_{Receiver}) were significantly correlated ($r = -0.348$, $p = 0.006$, $d = 0.742$, see Figure 2). As the ability to discriminate truthful from deceptive messages increased, the ability to produce deceptive messages that were hard to discriminate from truthful messages increased. Interestingly, a trend was observed for decreasing detectability in the Sender role to be associated with a reduced response latency difference between truthful and deceptive statements (Spearman’s $\rho = 0.259$, $p = 0.068$). The only significant association with either measure of bias (Truth-Bias or Credibility) was a correlation between the Sender’s confidence that they were believed and their Credibility measure, i.e., those that judged they were believed were more likely to be seen as honest independently

Performance Measures



$$P(\text{Hit}) = P(\text{"lie"} | \text{lie})$$

$$P(\text{False-Alarm}) = P(\text{"lie"} | \text{truth})$$

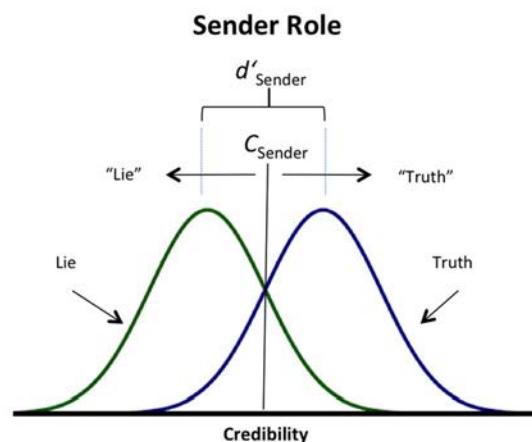
$$d'_{\text{Receiver}} = z[P(\text{Hit})] - z[P(\text{False-Alarm})]$$

$d'_{\text{Receiver}} = 0$ indicates an inability to distinguish other peoples' lies from truths.

A positive d'_{Receiver} indicates an ability to correctly distinguish lies from truths.

A negative d'_{Receiver} indicates the Receiver consistently judges lies and truths incorrectly.

$$C_{\text{Receiver}} = -0.5 \times \{z[P(\text{Hit})] + z[P(\text{False-Alarm})]\}$$



$$P(\text{Hit}) = P(\text{"truth"} | \text{truth})$$

$$P(\text{False-Alarm}) = P(\text{"truth"} | \text{lie})$$

$$d'_{\text{Sender}} = z[P(\text{Hit})] - z[P(\text{False-Alarm})]$$

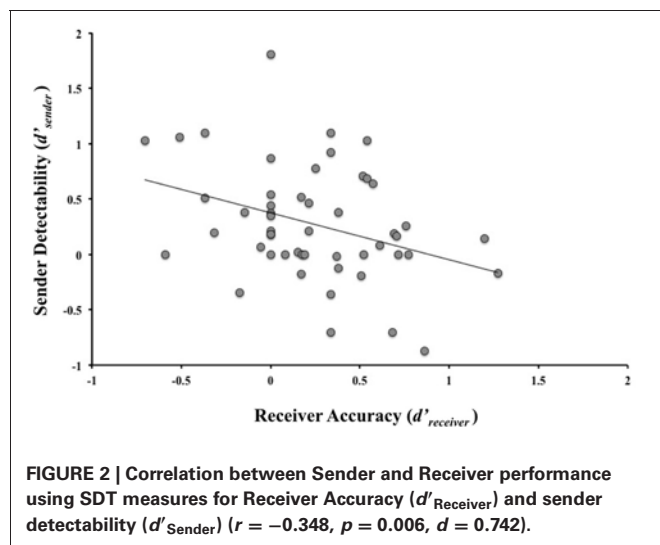
$d'_{\text{Sender}} = 0$ indicates that a Sender's lies and truths are indistinguishable.

A positive d'_{Sender} indicates that a Sender's lies and truths are consistently correctly distinguished as such.

A negative d'_{Sender} indicates a Sender's lies and truths are consistently incorrectly distinguished (i.e., the Sender is better at deceiving).

$$C_{\text{Sender}} = -0.5 \times \{z[P(\text{Hit})] + z[P(\text{False-Alarm})]\}$$

FIGURE 1 | Individual difference parameters for Senders and Receivers based on signal detection theory (SDT).



of the veracity of their statements (Spearman's $\rho = -0.316$, $p = 0.024$). Neither IQ (all r values < 0.184), emotional ability relating to the self (all r values < 0.198), nor empathy (all r values < 0.153) correlated with d'_{Receiver} , C_{Receiver} , d'_{Sender} or C_{Sender} .

DISCUSSION

The relationship between lie production and lie detection abilities was examined using a novel group Sender/Receiver deceptive interaction task (DeceIT) designed to address concerns over ecological validity stemming from the use of tasks that do not require social interaction and fail to generate or maintain motivation in participants (O'Sullivan, 2008). Results indicate that the current paradigm is comparable to previous studies with regards to the participants' self-reported experience of guilt, anxiety, and cognitive load during the task, and overall lie detection accuracy. In addition, previously reported chronometric cues to deception (Walczyk et al., 2003) were replicated in this study, with significantly longer response latencies when lying than when telling the truth. Moreover, as far as we are aware, this study is the first to provide evidence that the capacity to detect lies and the ability to deceive others are associated. This finding suggests the existence of a "deception-general" ability that may influence both "sides" of deceptive interactions.

At present the "deception-general" ability described above is little more than the association between performance on the deception production and detection task, the root of this ability is unknown. One can speculate that the association may be based upon personality characteristics (for example those relating to lie

acceptability or those affecting the degree of affective or cognitive consequences of deception), upon learning/experience (which may affect strategies used to detect deception and to appear less deceptive), or on general socio-cognitive ability (e.g., Theory of Mind) which can be called upon during deceptive interactions. However, the data presented here merely indicate that variance in deceptive performance is not a consequence of IQ or emotional ability. It is clear that identification of the precise nature of the proposed “deception-general” ability is an important aim for deception research, and that further research should be devoted to this question.

Interestingly, some evidence was observed for an association between Sender detectability and the difference in response latency between truthful and deceptive statements, with good liars demonstrating smaller differences in response latency. This suggests that, either implicitly or explicitly, Receivers were using Response Latency in order to discriminate truthful from deceptive statements and that good liars exhibited less of this cue. A question for further research is the extent to which the control of response latency is a deliberate and consistent strategy of successful liars.

A significant correlation was also observed between a Sender's confidence that they would be believed and their credibility, but not their discriminability. Therefore, participants could accurately judge the degree to which they would appear honest irrespective of whether they were lying or telling the truth, but neither their credibility, nor their confidence in appearing credible, was related to their success in producing lies that Receivers were less able to discriminate from truthful statements. This result bears striking resemblance to the finding that confidence in lie detection does not correlate with the ability to detect lies, but does correlate with the degree to which you judge others to be credible (DePaulo et al., 1997).

The absence of an association between IQ or emotional intelligence and the ability to produce or detect lies is in need of replication, but if supported, suggests that deceptive ability is not simply a product of cognitive or affective ability. Such a finding suggests deception-related knowledge structures that are used both to guide one's own behavior, and aid in the interpretation of another's behavior. The use of a shared representation system for both the self and the other is common e.g., “mirror neurons” code for one's own and another's action (Di Pellegrino et al., 1992), brain regions active when emotions are experienced by the self are active in response to the observation of another's emotion (Wicker et al., 2003; Singer et al., 2004), and primary and secondary somatosensory cortices are active upon observation of another being touched (Blakemore et al., 2005). The use of a shared representational system for self and other typically promotes the detection of corresponding states; for example, induced depression increases the degree to which faces are viewed as sad (Bouhuys et al., 1995), while execution of an action enhances perception of that action when executed by another (Casile and Giese, 2006). In the current study, however, the detection of deception in another was associated with the *control* of deception-related cues in the self. Further work is needed to identify the relationship between deceptive success, control of deceptive cues, and the use of a shared representational system.

Despite addressing what have been described as flaws in some of the previous research on deception, two further methodological issues must be discussed in relation to the use of the DecelT paradigm, which also apply to much of the experimental work on deception. These issues are related, and refer to the fact that in a typical experiment the experimenter usually, (1) sanctions the participant's lie, and (2), instructs the participant when to lie.

Many authors have commented negatively on the use of sanctioned lies in experimental studies of deception, arguing that the use of sanctioned lies results in the liar feeling less guilt (Ekman, 1988; Vrij, 2000), less motivation to lie and, therefore, less accompanying arousal and cognitive effort (Feeley and de Turck, 1998), and less “decision-making under conflict” (Sip et al., 2008). These arguments suggest that the use of sanctioned lies in experimental studies results in a reduction in the available cues to detection. However, empirical studies of sanctioned versus unsanctioned lies reveal very few consistent differences between cues exhibited during both types of lie. Feeley (1996) found that interviewers could detect no differences in the behavior of participants telling sanctioned or unsanctioned lies, while Feeley and de Turck (1998) found that more cues to deception were associated with sanctioned lies, than with unsanctioned lies. In their meta-analysis of deception detection studies, Sporer and Schwandt (2007) identified only one deceptive cue (smiling) from the 11 studied that differed as a result of whether the lie was sanctioned or unsanctioned.

The use of sanctioned lies in experiments has also been criticized due to a claimed lack of ecological validity. However, proponents of the use of sanctioned lies in the laboratory argue that even if levels of motivation and cognitive effort are reduced through the use of sanctioned lies, the net effect may be to make the deception more ecologically valid. In everyday life most lies are unplanned, of little importance, and of no consequence if detected (DePaulo et al., 1996; Kashy and DePaulo, 1996). In addition, the types of sanctioned lie used in most laboratory studies of deception (including the present study) involve false reports about attitudes to issues or individuals, and are precisely those most often told in everyday communication (DePaulo and Rosenthal, 1979; Levine and McCornack, 1992; Feeley and de Turck, 1998). These lies are often sanctioned by society when used to, for example, bolster another's ego (“white lies”), while more important lies may be sanctioned by the liar's religion, political party, friends/family, or ideals.

Instructed lies have also been argued to lack ecological validity—it has been suggested that rather than lying, participants are merely following the experimenter's instructions (e.g., Kanwisher, 2009). As a result it has been argued that participants should be free to choose when, and if, they lie during an experiment (e.g., Sip et al., 2010). Issues regarding statistical power and experimental control notwithstanding, we suggest that the basic premise that instructed lies are not ecologically valid may be flawed. For example, employees may be instructed to lie to a client or regulator by their supervisor, children may be instructed to lie to family members by their parents, and many people are compelled to lie by the situation they are in (in response to financial, legal, or moral pressure). Therefore, the choice of when to lie may not always truly exist in everyday life. Furthermore, solely

studying non-instructed lies in an experimental setting may induce experimental confounds relating to confidence. In an experiment where the participant can choose whether or not to lie, it is likely to be the case that they only tell lies that they are confident are likely to be successful. Neuroimaging studies, therefore, when attempting to elucidate neural activity differentiating lies from truths, may instead identify neural activity differentiating topics about which participants believe they can lie successfully (which may be topics about which they do not hold a strong opinion) from those that they believe they cannot lie successfully about (potentially topics about which they do have a strong opinion). Across participants, the number of lies told is also likely to vary as a function of the participant's belief that they are a good liar, meaning that in any corpus of lie items the majority will be contributed by participants who believe they are good liars. Whether this participant sampling error will result in a distribution of lies which is skewed relative to an ecologically valid distribution of lies depends both on the degree to which individuals have control over when to lie in everyday life, and the degree to which instructed lies are qualitatively different from lies freely chosen. Both of these factors are presently inestimable given current data.

The implications of the arguments pertaining to the study of sanctioned and instructed lies in relation to the DecelT paradigm are unclear. Although the participant is given "permission" to lie by the experimenter, thus lies are both sanctioned and instructed—lies are not directed toward the experimenter, but instead to other participants who have not given their permission, and, due to the competitive scenario, are disadvantaged by the participant lying successfully. Furthermore, in the present study, levels of cognitive effort, guilt and anxiety were all significantly elevated during deceptive trials; indicating that the hypothesized reduction in guilt, motivation, and cognitive effort as a result of sanctioning lies was at least minimized using the DecelT paradigm.

As discussed previously, it has been argued that the ability to deceive successfully, and to detect deception, each confer an evolutionary advantage (Dawkins and Krebs, 1979; Bond and Robinson, 1988). Indeed, several authors argue that the increasing utility of deception with larger social group size has driven the increase in neocortical volume observed in humans (Trivers, 1971; Humphrey, 1976) and other primates. Byrne and Corp (2004) demonstrated that among modern primate species there is an association between neocortex size and the use of tactical deception, with those species with neocortex sizes closer to humans engaging in more tactical deception.

These results do not necessarily imply that the *ability* to lie itself is genetically determined; it is possible that deception is a function of learning within social contexts and that different individuals have different propensities to learn socially (Cheney et al., 1986; Byrne, 1996). These individual differences in social learning may come about as a result of genetically determined differing levels of attention to conspecifics for example (Heyes, 2011). Bond et al. (1985) advance a third possibility in which individuals inherit a "demeanour bias," which determines the degree to which other species members are likely to judge their statements as deceptive (indexed by Sender Credibility, C_{Sender} , in the current study). They suggest that individuals with a demeanour bias that results in a high probability of deceptive success are likely to use deception frequently and, therefore, improve their abilities. Conversely, those with a demeanour bias leading to a low probability of being judged truthful, are likely to learn quickly that deception is not a successful strategy for them and, therefore, to use alternative strategies. The association between a Sender's confidence that they would be believed and their credibility/demeanour bias in the present experiment lends support to this hypothesis. It suggests that individuals track their demeanour bias and associate it with the probability of lie success.

In summary, the present study employed an interactive deception task designed to address ecological-validity concerns (O'Sullivan, 2008) and allow the within-subject comparison of deception production and detection ability. The paradigm brings motivated Senders and Receivers together in a competitive, interactive setting, and allows Receivers full access to both verbal and non-verbal cues to deception. The key finding was that Receiver accuracy and Sender detectability were reliably associated: better lie detectors tended to be better deceivers, suggesting some underlying "deception-general" ability that transfers to both aspects of deceptive engagements. Deception has been argued to be a difficult task to undertake successfully, but with the potential to confer evolutionary advantage (Spence, 2004). As proposed by Serota et al. (2010) and supported by evidence from this experiment, a small percentage of individuals may have the skills necessary to effect deception successfully, and to detect deception in their interaction partners.

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Deceptively simple . . . The “deception-general” ability and the need to put the liar under the spotlight

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This Focused Review expands upon our original paper (You can't kid a kidder": Interaction between production and detection of deception in an interactive deception task. *Frontiers in Human Neuroscience*, 6:87). In that paper we introduced a new socially interactive, laboratory-based task, the Deceptive Interaction Task (DecelIT), and used it to measure individuals' ability to lie, their ability to detect the lies of others, and potential individual difference measures contributing to these abilities. We showed that the two skills were correlated; better liars made better lie detectors (a “deception general” ability) and this ability seemed to be independent of cognitive (IQ) and emotional (EQ) intelligence. Here, following the Focused Review format, we outline the method and results of the original paper and comment more on the value of lab-based experimental studies of deception, which have attracted criticism in recent years. While acknowledging that experimental paradigms may fail to recreate the full complexity and potential seriousness of real-world deceptive behavior, we suggest that lab-based deception paradigms can offer valuable insight into ecologically-valid deceptive behavior. The use of the DecelIT procedure enabled deception to be studied in an interactive setting, with motivated participants, and importantly allowed the study of both the liar and the lie detector within the same deceptive interaction. It is our thesis that by addressing deception more holistically—by bringing the liar into the “spotlight” which is typically trained exclusively on the lie detector—we may further enhance our understanding of deception.

Keywords: “deception-general” ability, signal detection theory, deception, lying, social cognition

INTRODUCTION

Besides being a topic of enduring fascination to laymen, deception has stimulated a vibrant field of scientific enquiry across numerous distinct research disciplines including (but by no means limited to) philosophy, psychology, economics, criminology, and in recent years, neuroscience. Despite this long, inter-disciplinary tradition,

doubt appears to exist as to the possible future direction of deception research. This doubt has largely been due to discussions of the utility (or futility) of laboratory-based deception research (Vrij and Granhag, 2012). What follows is a brief general introduction to the field, highlighting key findings and an overview of the methods employed to uncover them. We hope that this

will lead to an understanding of the context within which the original research (Wright et al., 2012) was formulated.

Our original paper aimed to address some of these methodological criticisms of laboratory-based research, but most significantly, to focus on the skill of the liar in addition to the lie detector. A new, socially interactive, task was developed in which participants were motivated by competition and high-value prizes. Results were analyzed using the novel application of **signal detection theory** to measure lie production ability, alongside the ability to detect lies. The main goal of the research was to assess whether skill in the production and detection of lies were correlated, that is, to assess whether good lie detectors made good liars. The results and implications of the research, most notably the description of a **"deception-general" ability** contributing to both production and detection of deception, are presented and it shall be argued that laboratory-based studies of deception are not only valid, but constitute an area ripe for theoretical development (see also Frank and Svetieva, 2012).

Deception is a ubiquitous aspect of everyday human interaction and remarkably varied in the forms it can take, the contexts in which it can occur and the motives ascribed to its perpetrators (DePaulo et al., 1996; Kashy and DePaulo, 1996). Any taxonomy of deceptive human interaction will necessarily include such diverse concepts as white lies, bluffing, lies of omission, malingering and even sarcasm (Levine, 2010). A commonly used definition of deception, which attempts to incorporate all forms of deception, is "a successful or unsuccessful deliberate attempt, without forewarning, to create in another a belief which the communicator considers to be untrue" (Vrij, 2000, p. 15). In spite of this common starting point, the ways in which deception is operationalized in the laboratory setting are still hugely varied, and almost universally problematic in some regard. It is important to note however, that central to this depiction of deception is the inherent interpersonal or social component; there is a deceiver and the deceived—the liar and the lie detector.

DETECTING DECEPTION

Whether explicitly or not, the majority of deception research has focused on lie detection. Studies have examined individual differences in lie detection ability, factors that may predict the ability of an individual to detect deception, and strategies, cues or technologies designed to improve lie detection (Vrij and Granhag, 2012).

From lie detection studies such as these a number of robust results have been observed. For detailed analysis, interested readers are directed toward three comprehensive meta-analyses by DePaulo et al. (2003); Bond and DePaulo (2006, 2008).

The first of these meta-analyses (DePaulo et al., 2003) examined a range of 158 cues for their predictive utility to discriminate honest and deceptive behavior. Although several cues were found to be predictive of deception (such as response duration and vocal pitch), each was only very loosely related to deception across studies such as to be of almost no use in detecting deception given large variance in the expression of those cues within an individual, even when telling the truth, and the large degree of variance in the extent to which the cues are displayed across individuals (Levine et al., 2005). The second meta-analysis (Bond and DePaulo, 2006) focused on the accuracy of lie detection (based on a corpus of nearly 24,500 veracity judgments), and found mean "lie detection" performance to be in the region of 54% accuracy, with most studies falling within 10% of this figure (Levine, 2010). Although not much higher than may be expected by chance, this rate is nonetheless significantly different from chance. The 54% accuracy referred to above is the percentage of all statements judged which are correctly identified as truth or lie. When examined separately, accuracy at correctly identifying truths is generally higher (approximately 65%) than the rate at which lies are correctly identified as lies (approximately 40%). This **"Veracity Effect,"** is often attributed to a commonly reported response bias observed in naïve lie detectors, the so-called **"Truth Bias."** The design of the majority of lie detection tasks usually involves 50% of stimulus items being truthful and 50% deceptive. It is observed that individuals usually identify more statements as truthful than as deceptive (around 60–65%), and therefore this response bias could account for the increased accuracy for truthful statements over deceptive ones. The inadequacies of these blunt percentage accuracy figures are discussed and a potential solution proposed in a later section describing our Signal Detection Theory analytic framework.

That no universal deception cue has yet been identified is perhaps the most broadly reported result in the literature. Similarly robust is the finding that no single individual difference measure is reliably related to deception detection accuracy when individuals perform deception detection tasks (Aamodt and Custer,

Signal detection theory

An analysis technique traditionally used in psychophysics whereby the sensitivity (d') and bias (C) of a Receiver are independently estimated. Outlined in the current paper is an approach designed to apply this technique to Sender performance offering similar benefits.

"Deception-general" ability

Refers to the recent finding that the abilities to detect and to produce deception successfully may be related. IQ and measures of self- and other-focused emotional intelligence are not correlated with this deception-general ability, further research is required to understand the contributing psychological or cognitive processes involved.

Veracity effect

The finding that when considered separately, truthful statements are more usually correctly classified as such than lies correctly identified as lies. Potentially a statistical artefact due to the Truth Bias.

Truth bias

A common response bias in lie detection tasks whereby Receivers will tend to make more "Truth" ratings than would be expected by chance. Usually lie detection experiments use an equal amount of truthful and deceptive stimuli, thus participants typically judge more than half of all stimuli as truthful.

2006). The failure on behalf of behavioral psychology to identify reliable correlates of lying has prompted the application of neuroscience techniques such as electroencephalography and functional Magnetic Resonance Imaging (fMRI) in an attempt to identify a neurological signal of lying. Debate surrounding the accuracy and utility of these techniques has been fierce, but several studies have provided promising evidence for the identification of deceptive patterns of brain activity using fMRI (e.g. Hakun et al., 2009; Monteleone et al., 2009), although countermeasures can be developed which may render the technique useless in practice (Ganis et al., 2011).

THE IMPORTANCE OF THE LIAR

An interesting feature of the empirical literature on lie detection is that the selection of stimulus material is usually only briefly described in journal articles and examples are rarely published. The apparent assumption is that lies are invariant in quality and all lies will necessarily display some "deceptive evidence" that an accurate judge will be able to perceive and correctly attribute to attempted deception. In contrast to this view, a meta-analysis by Bond and DePaulo (2008) suggests that the outcome of any individual deceptive engagement between liar and lie detector may be more attributable to the skill (or lack thereof) of the liar than any acuity on the part of the lie detector. In spite of these data, only a small minority of studies has made any attempt to determine individual differences in the ability to lie (and tell the truth) credibly (e.g., DePaulo and Rosenthal, 1979; Riggio et al., 1987). Thus, a focus on the liar constituted one of the main aims of our original study.

WHAT'S WRONG WITH STUDYING LYING IN THE LAB?

A debate rages around the ecological validity of studying deception in the lab, with some researchers arguing that lab studies are impossible to generalize to applied contexts and so therefore contribute little to our understanding of real-world deception. Criticism usually include 5 specific features of deception paradigms, including (1) the use of instructed lies, (2) the sanction of experimental lies, (3) low motivation experienced by participants, (4) low stakes for failure, and (5) limited social interaction.

Instructed lies

Participants recruited to act as liars or truth tellers are usually instructed to either lie or tell

the truth upon experimental cues. The fact that an experimenter instructs the participant to lie or tell the truth is argued by some to remove the essence of deception by not giving the perpetrator the option to lie or tell the truth—that instead of lying, participants are merely following instructions (e.g., Kanwisher, 2009). Of course this feature of deception paradigms is not intrinsic to deception itself, and therefore experimental paradigms can, and have been, developed which remove instruction and allow participants to choose when to lie (e.g., Sip et al., 2010, 2012). The use of uninstructed paradigms introduces further problems however; including lower rate of lies produced in such situations which impacts upon statistical power and experimental control. Furthermore, allowing participants to choose when to lie is likely to introduce an experimental confound relating to confidence or strength of opinion. It is possible that participants may only choose to tell lies about issues that they can confidently lie about. These issues are likely to be those things that matter least to them, or issues for which they already have well-rehearsed lies. It has been argued that removing the choice about whether to lie means that the experimental study lacks ecological validity (Kanwisher, 2009), but we suggest that it is not always the case that in real-life we can choose when to lie and when to tell the truth. There may be many occasions where prior behavior, job or family roles, or social or moral imperatives demand deception even though the individual may not want to lie, or be confident about successfully doing so.

Sanctioned lies, low motivation, and low fear of failure

That lies are sanctioned in experimental settings, thereby removing the element of moral transgression, associated risk of punishment, and possible related feelings of guilt, anxiety and cognitive load (Caso et al., 2005) is a common criticism leveled at deception paradigms (Frank and Ekman, 1997). It is argued that removing the threat of punishment, which would normally accompany being uncovered as a liar, limits the availability of verbal and behavioral cues elicited by lying, in particular those cues relating to arousal and cognitive effort. In turn, it is argued that the absence of these cues contributes to the exceedingly poor rates of deception detection in experimental paradigms. Experimental evidence does not support this conjecture however; Feeley (1996) found no difference in the accuracy of judgments made by recipients of either sanctioned or unsanctioned lies, while

Feeley and de Turck (1998) showed evidence that sanctioned lies were more commonly associated with behavioral cues to deception than unsanctioned lies. This result was recently replicated in our lab. Indeed, Sporer and Schwandt (2007) performed a meta-analysis of 11 studies and the only "deceptive cue" which differed as a result of sanction was smiling, in that smiles tended to increase when lies were unsanctioned.

Motivation

A related issue concerns the motivation to lie. It has often been argued that the low level of motivation to succeed when lying, and low fear of failure, mean that experimental studies of deception lack ecological validity. This argument is presented in two different ways—one version of the argument suggests that as the stakes for success or failure in the lab are much reduced compared to real life (as a result of sanctioned lies for example), participants may not try as hard to effect successful deceit. Conversely, it is also argued that real-life deception may be less successful than in the lab because the greater motivation to successfully deceive in real life (due to the higher stakes for success and failure) may lead to a difficulty in effecting successful deception, a so-called "Motivational Impairment Effect" (DePaulo and Kirkendol, 1989). In response to both of these criticisms we would question the assumption that all instances of deception in everyday life are of sufficient importance to cause high motivation. Indeed, observational studies suggest that most lies in everyday life are unplanned, of minimal importance and of little consequence if detected (DePaulo et al., 1996; Kashy and DePaulo, 1996). Although some researchers have argued previously that only high stakes (such as a criminal conviction) may be suitable for ecological examinations of deception, a greater awareness of the range of lies told in everyday life has led to a softening of this view (Vrij and Granhag, 2012).

Social interaction

In our view more worrisome than the factors discussed so far is the lack of social interaction in experimental studies of deception. Although deception is an inherently dynamic social interaction (Buller and Burgoon, 1996), only 9% of studies in a meta analysis by Bond and DePaulo (2006) featured any real interaction between the **Sender** of lies and the individuals tasked with their detection (**Receivers**). Stimulus material in lie detection tasks is usually pre-recorded (in written, video, or audio form), thus permitting limited access to potentially useful cues

to deception not portrayed by these media. It is worth highlighting that without a live audience, the performance of the Sender may also be impacted since a video camera gives no feedback or sense of social contingency. In this regard, researchers examining investigative interview strategies have maintained an important aspect of everyday deception by virtue of using socially interactive paradigms (e.g. Hartwig et al., 2006). Interestingly, neuroscientists such as Sip and colleagues have frequently argued for the need for a social dimension to deception research and have implemented this within their fMRI designs investigating deception (Sip et al., 2010, 2012).

Thus, with the goal of focusing upon the liar and addressing the most theoretically relevant individual difference measure with regards to lie detection accuracy—the ability to deceive—we developed a paradigm addressing a number of the criticisms aimed at previous laboratory studies. Primarily, we hoped to address the lack of social interaction and the low motivation of participants using an interactive competitive game played for high value cash prizes. While participants were instructed whether to lie or to tell the truth on each trial, lies were directed to other participants who stood to lose if they did not detect the deception. Therefore the recipient of the lie did not sanction the lies. As detailed in the original article, we hypothesized the existence of a "deception-general ability" whereby the ability to deceive and the ability to detect deception may be related, with cognitive (Spence et al., 2004) and emotional intelligence (Sip et al., 2010) contributing to both processes. Although this review focuses on the findings from the first iteration of this novel Deceptive Interactive Task (DeceIT), the key finding of a deception-general ability has since been replicated by our group (Wright et al., submitted) and awaits examination in other labs.

MATERIALS AND METHODS

PARTICIPANTS

Fifty one healthy adults (27 female, mean age = 25.35 years, $SD = 8.54$) with English as a first language participated in the study. All participants provided written informed consent to participate and for data to be collected. The local Research Ethics Committee (Dept. of Psychological Sciences, Birkbeck College) granted ethical approval for the study.

PROCEDURE

Participants volunteered to take part in a "Communication Skills" experiment and were

Sender

The communicator of a message. In deception detection paradigms this constitutes the liar (or truth teller). Although Senders are by necessity part of experimental tasks, their performance is rarely reported. Such performance is argued to be critical to the outcome of a deceptive encounter.

Receivers

In deception detection tasks, the individual tasked with making the judgment will often be referred to as the Receiver. Historically, this has been the focus of interest in deception research, be it individual differences in accuracy, predictors of accuracy, or methods of training improved performance.

randomly assigned to nine groups of five participants and one group of six participants, with the constraint that group members were not previously known to each other. Participants were seated in a circle and asked to complete an "Opinion Survey" questionnaire. The questionnaire comprised 10 opinion statements (e.g., "Smoking should be banned in all public places") to which participants responded "agree" or "disagree." Responses to the Opinion Survey served as ground truth in the subsequent task (c.f. Mehrabian, 1971; Frank and Ekman, 2004). Participants also completed the Toronto Alexithymia Scale (TAS—Parker et al., 2001), a measure of the degree to which emotions can be identified and described in the self, and the Interpersonal Reactivity Index (IRI—Davis, 1980), a measure of empathy. These instruments provide self- and other-focused measures of emotional intelligence (Mayer et al., 1999; Parker et al., 2001). A subset of participants ($n = 31$, 61% of sample) also completed the Wechsler Abbreviated Scale of Intelligence (WAIS—Wechsler, 1999).

Participants were then informed that they were to participate in a competitive "game" against the other participants in their group that was designed to test their communication skills. They were told that two high value (£50) prizes would be awarded; one to the participant who was rated as most credible across all trials and the other to the participant who was most accurate in their judgments across all trials. Participants were required to make both truthful and dishonest statements relating to their answers on the prior "Opinion Survey," with the objective being to appear as credible as possible regardless of whether they were telling a lie or the truth. Participants played the role of both "Communicator" (Sender) and "Judge" (Receiver), and their role changed randomly on a trial-by-trial basis, with topic being similarly randomized.

On each trial, the experimenter presented one participant with a cue card, facedown, specifying a topic from the "Opinion Survey" and an instruction to lie or tell the truth on that trial. This indicated to all participants the Sender for the upcoming trial. At a verbal instruction to "go," the participant turned the card, read the instruction, and then spoke for approximately 20 s, presenting either their true or false opinion and some supporting argument. After the presentation of the format of the task, a practice trial was conducted for all participants and the experimenter presented a verbatim example response from the piloting phase of the

study. This permitted each participant to fully preview the requirements of both Sender and Receiver roles. Following each trial, Senders were required to rate whether they thought they had been successful or unsuccessful in appearing credible using a binary "credible" or "not credible" response scale. Simultaneously, Receivers rated whether they thought the opinion given by the Sender was true or false by marking "Truth" or "Lie" on their response form. Each participant completed 10 or 20 trials as Sender, half with their true opinion and half with their false opinion. Statistical analysis demonstrated that performance did not vary as a function of the number of statements produced and so this variable is not analyzed further. The 50:50 lie-truth ratio was not highlighted to the participants at any stage to prevent strategic responding in either the Sender or Receiver roles. Following the task, participants were asked to rate the degree to which they experienced guilt, anxiety and cognitive load when lying and when telling the truth, each on a 5-point Likert scale ranging from 1 (not at all) to 5 (extremely).

ANALYZING DECEPTION DETECTION DATA USING SIGNAL DETECTION THEORY

In deception detection experiments, researchers often wish to measure two aspects of performance: (1) the ability of receivers to discriminate lies from truths, and (2) the receiver's tendency to classify messages as true (truth bias). (1) Is typically measured as the percentage of messages that are correctly classified by the receiver (lies classified as lies and truths classified as truths). Greater than chance performance (i.e., performance that is greater than would be expected if based upon guessing) is therefore indicated by a percentage correct score greater than 50%. (2) Is most commonly indexed as the percentage of truth classifications made (across all messages); scores greater than 50% therefore indicate a general truth bias. One limitation of measuring (1) using the percentage correct measure is that, when the proportions of lie and truth messages are unequal, this measure is not independent of (2). For example, suppose that a receiver has a general tendency to classify messages as truths. If a greater proportion of true messages than false messages are presented to the receiver, then the receiver will most likely score above 50% when the percentage of correct classification score is calculated, but this will be a false impression of their detection ability: their accuracy is confounded by their truth bias. This limitation of the use of the percentage correct measure in deception research has

been noted by other researchers (e.g., Bond and DePaulo, 2006). Thus, the use of the percentage correct measure is typically confined to circumstances in which there are an equal proportion of truth and lie messages, or a weighted version of the percentage correct measure is used when the proportion of lie and truth messages are unequal.

Signal detection theory is a well-established framework (Green and Swets, 1966), which can be used to provide alternative measures of detection discriminability and truth bias. Importantly, measures can be derived that are not confounded, and can be used when there are unequal proportions of lie and truth messages to be classified. In place of the percentage of correct classifications and the percentage of truth classifications, the signal detection measures of d' and C can be used, respectively. Using this framework, a "hit" (H) can be defined as a "lie" classification to a lie message, and a "false alarm" (FA) can be defined as a "lie" classification to a truth message. d' can then be calculated as the difference in the z transformed proportions of hits and false alarms (i.e., $d' = z(p(H)) - z(p(FA))$). A positive d' score therefore indicates a tendency to correctly distinguish lies from truths. The measure of bias, C , can be calculated as $C = -0.5 \times [z(p(H)) + z(p(FA))]$. A negative value of C therefore indicates a truth bias, and a positive value of C indicates a bias to classify messages as lies.

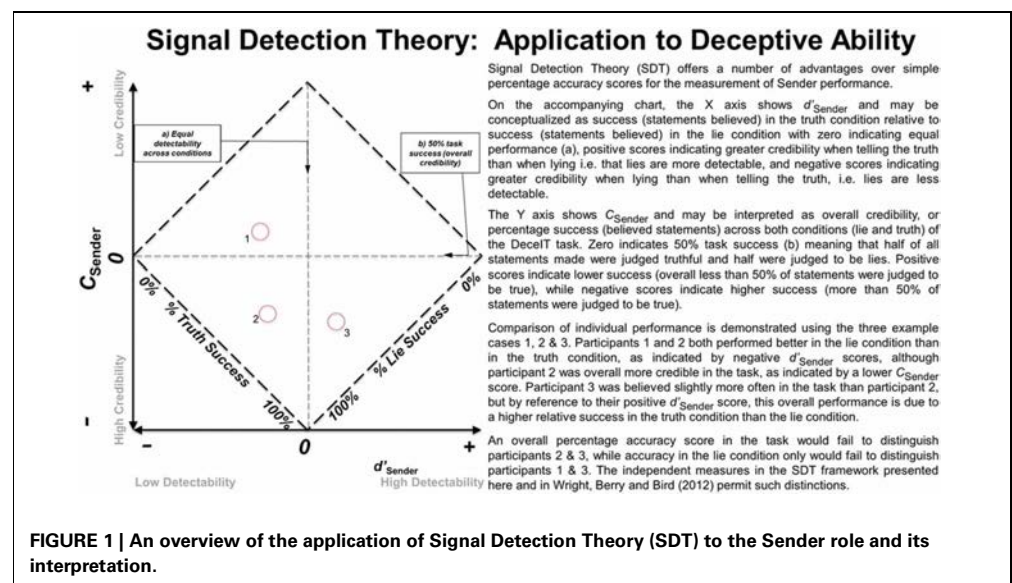
THE ANALYSIS OF DECEPTION PRODUCTION DATA USING SIGNAL DETECTION THEORY

Wright et al. (2012) showed that signal-detection measures could also be effectively

applied to index the deceptive abilities of the Senders of truth and lie messages. Similar benefits arise from the use of independent measures of d' and C in the Sender role as these index Discriminability (or the extent to which a Senders' lies and truth messages can be correctly distinguished) and Credibility (the extent to which a Senders' messages as a whole tend to be rated as truthful), respectively. Sender Credibility, as indexed by C may be thought to be analogous with the "Demeanor Bias" mentioned previously. Full details of the analysis strategy and the interpretation of results can be found in Wright et al. (2012) and Wright et al. (submitted). An overview of the application of SDT to deception research is provided in Figure 1. A major advantage of characterizing the performance of Receivers and Senders with the same measures (d' and C) for each role was that it facilitated an analysis of the relationship between the measures across roles.

RESULTS

In line with previous studies (Caso et al., 2005) participants reported greater Guilt, Anxiety and Cognitive Load when lying than when telling the truth [statistics: Guilt $t_{(50)} = 7.060$, $p < 0.001$, $d = 1.226$, Anxiety $t_{(50)} = 9.598$, $p < 0.001$, $d = 1.784$, Cognitive Load $t_{(50)} = 9.177$, $p < 0.001$, $d = 1.421$]. Also in common with previous studies (Walczyk et al., 2003), Response Latency was significantly shorter when participants told the truth [$M = 4.6$ s, $SD = 2.0$] than when they lied [$M = 6.5$ s, $SD = 3.1$, $t_{(50)} = -3.885$, $p < 0.001$, $d = 0.728$]. Finally, task performance in the Receiver role was analyzed using conventional percentage accuracy rates



Demeanor Bias

Characteristics that contribute to the extent to which an individual Sender may be believed (or not) due to general appearance or communicative style.

and overall accuracy was found to be 54.1% ($SD = 8.7\%$), not significantly different to the 54% reported previously (Levine, 2010) [$t_{(50)} = 0.065$, $p = 0.950$, $d = 0.013$] but significantly greater than chance [$t_{(50)} = 3.335$, $p = 0.002$, $d = 0.667$]. Fractional rates addressing accuracy for different types of statement showed a significantly lower mean accuracy for truths ($M = 51.1\%$, $SD = 11.9\%$) than for lies [$M = 57.1\%$, $SD = 10.5\%$, $t_{(50)} = -3.731$, $p < 0.001$, $d = 0.746$]. To compare any response bias in the Receiver role with findings from the literature, we calculated the number of statements of all types classified by Receivers as truthful and found it to be 46.7% ($SD = 8.8\%$) a figure significantly lower than chance [$t_{(50)} = -2.667$, $p = 0.005$, $d = 0.535$].

Large individual differences were observed in all of the four performance measures analyzed using Signal Detection Theory ($M d'_{\text{receiver}} = 0.242$, $SD = 0.418$; $M C_{\text{receiver}} = -0.086$, $SD = 0.233$; $M d'_{\text{sender}} = 0.272$, $SD = 0.509$; $M C_{\text{sender}} = 0.097$, $SD = 0.256$). Of principal interest is the fact that detectability in the Sender role (d'_{sender}) and the ability to discriminate in the Receiver role (d'_{receiver}) were significantly correlated ($r = -0.348$, $p = 0.006$, $d = 0.742$, see **Figure 2**). As the ability to discriminate truthful from deceptive messages increased, the ability to produce deceptive messages that were hard to discriminate from truthful messages increased. Interestingly, a trend was observed for decreasing detectability in the Sender role to be associated with a reduced response latency difference between truthful and deceptive statements (Spearman's $\rho = 0.259$, $p = 0.068$, *post-hoc*). The only significant association with either measure of bias (Truth-Bias or Credibility) was a correlation between a Sender's confidence that they were believed and their Credibility measure, i.e., those that

judged they were believed were more likely to be seen as honest independently of the veracity of their statements (Spearman's $\rho = -0.316$, $p = 0.024$, *post-hoc*). Neither IQ (all r values < 0.184), emotional ability relating to the self (all r values < 0.198), nor empathy (all r values < 0.153) correlated with d'_{receiver} , C_{receiver} , d'_{sender} , or C_{sender} .

DISCUSSION

The relationship between the abilities to successfully produce and accurately detect deception was examined using a novel group Sender/Receiver deception task (DeceIT). This paradigm addressed widespread concerns around ecological validity in that it was socially interactive (rather than video-mediated) and sought to increase and maintain motivation in participants by introducing a competitive element with high-value monetary rewards. The reported results were comparable to patterns of results reported in the deception literature with regards to increased self-reported guilt, anxiety and cognitive load while performing the task (Caso et al., 2005), as well as the overall percentage detection accuracy rate (Levine, 2010). Furthermore, chronometric cues related to deception were replicated, whereby significantly longer response latencies were recorded for statements in which participants lied than when they told the truth about their opinion (Walczyk et al., 2005). The finding that the ability of individuals to detect deception and to successfully deceive were positively associated, is interpreted to suggest the existence of some form of "deception-general" ability, contributing to success in both roles within a deceptive encounter.

Interpreting the "deception-general" ability given the data currently available is very difficult. Deceptive skill was unrelated to IQ or self-report measures of self- or other-focused emotional intelligence. We tentatively suggest that it may be a product of practice or vigilance in everyday life through social learning (Cheney et al., 1986; Byrne, 1996) or attention to conspecifics more generally (Heyes, 2012). Speculatively, this practice may enable the individual to develop a model, likely to be implicit in nature, that they can apply in a deceptive encounter to either modulate their own behavior or to assess the behavior of another. Whether individual difference variables such as social motivation, social attention, or theory of mind contributes to the speed with which one develops a model of deceptive behavior, and therefore a deception-general ability, is at present an

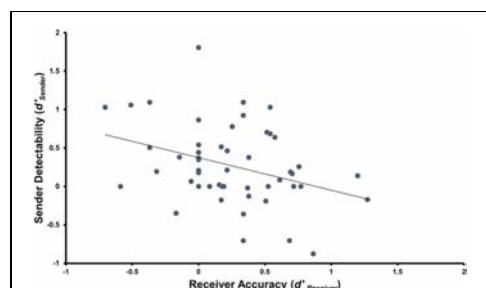


FIGURE 2 | Correlation between Sender and Receiver performance using SDT measures for Receiver Accuracy (d'_{receiver}) and Sender Detectability (d'_{sender}) ($r = -0.348$, $p = 0.006$, $d = 0.742$).

unanswered question. Gaining a comprehensive understanding of how people differ in their ability and propensity to deceive is an important research aim, and a present focus of our lab.

To summarize, our recent discovery of a "deception-general" ability, conferring advantage to some individuals over others in both aspects of deception, is a potentially powerful interpersonal tool delivering a competitive edge for resources and social position. We have argued that our DeceIT paradigm and Signal Detection Theory based analytic technique provide the tools to finally turn the spotlight on the liar, a variable of interest in deception research whose time was long overdue. We have shown that DeceIT addresses a number of the methodological concerns around sanction, low stakes and social interaction highlighted above. We have further suggested that lab-based research is not distinct from the vast majority of real-world deception in terms of the penalty for being caught lying, we cite evidence describing real-world lies as being frequent and often of little consequence if discovered (DePaulo et al., 1996; Kashy and DePaulo, 1996).

We have promoted the adoption of SDT techniques in future research to index the performance of both Senders and Receivers, of liars and lie detectors. Although the SDT measures initially seem less transparent than traditional percentage accuracy scores, they capture all aspects of performance relevant for deception.

One can gain independent measures of an individual's skill when deceiving, their credibility or demeanor bias, their ability to detect lies, and their degree of credulity, or truth bias. These measures are confounded in traditional percentage accuracy scores. Furthermore, percentage accuracy scores, but not SDT measures, are susceptible to biases induced through factors such as the proportion of lies and truths presented to participants during the experimental task.

Certain researchers, deeply ensconced in the field, may appear somewhat frustrated or urge a wholesale change of direction in deception research. However, in keeping with the idea that it is often "darkest before the dawn," we promote a renewed vigor in deception research, both in the lab and within applied settings. An important element of this drive must be the broadening of research goals beyond that of lie detection, to include lie production ability, and the mechanisms of credibility and trustworthiness that contribute to it, leveraging all the tools, insights and theoretical advancement that interdisciplinary collaboration promises.

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DETECTING DECEIT VIA ANALYSIS OF VERBAL AND NONVERBAL BEHAVIOR

Aldert Vrij, Katherine Edward, Kim P. Roberts, and Ray Bull

ABSTRACT: We examined the hypotheses that (1) a systematic analysis of nonverbal behavior could be useful in the detection of deceit and (2) that lie detection would be most accurate if both verbal and nonverbal indicators of deception are taken into account. Seventy-three nursing students participated in a study about "telling lies" and either told the truth or lied about a film they had just seen. The interviews were videotaped and audiotaped, and the nonverbal behavior (NVB) and speech content of the liars and truth tellers were analyzed, the latter with the Criteria-Based Content Analysis technique (CBCA) and the Reality Monitoring technique (RM). Results revealed several nonverbal and verbal indicators of deception. On the basis of nonverbal behavior alone, 78% of the lies and truths could be correctly classified. An even higher percentage could be correctly classified when all three detection techniques (i.e., NVB, CBCA, RM) were taken into account.

KEY WORDS: detecting deceit; nonverbal behavior; Criteria-Based Content Analysis; Reality Monitoring.

There are, in principle, three ways to catch liars: (1) by observing how they behave (the movements they make, whether or not they smile or show gaze aversion, their pitch of voice, their speech rate, whether or not they stutter, and so on), (2) by listening to what they say (analyzing the speech content), and (3) by measuring their physiological responses. In order to measure physiological responses, several polygraph test procedures have been developed such as the Control Question Test (Raskin, 1979, 1982, 1986; Reid, 1947) and the Guilty Knowledge Test (Lykken, 1960, 1998). Deception detection techniques based on what a person says include Con-

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tent-Based Criteria Analysis (CBCA) (Köhnken, 1990, 1996; Steller & Köhnken, 1989) and Reality Monitoring (RM) (Porter & Yuille, 1996; Sporer, 1997). David Raskin and Gunter Köhnken—leading experts in lie detection via physiological responses and via what is said, respectively—both believe that detecting deception via nonverbal behavioral cues is a precarious exercise on which people cannot rely (Köhnken, 1997, personal communication; Raskin, 1996, personal communication).

Research, so far seems to support this pessimistic view. When detecting deceit via nonverbal cues, accuracy rates (percentage of correct answers) usually vary between 45 and 60 percent, when a 50% accuracy rate would be obtained by tossing a coin (DePaulo, Stone, & Lassiter, 1985a; Kraut, 1980; Vrij, 2000). If accuracy at detecting lies is computed separately from accuracy at detecting truths, it emerges that people are particularly poor at detecting lies. In a recent review including approximately 40 studies, Vrij (2000) found a 67% accuracy rate for detecting truths and a 44% accuracy rate for detecting lies. (The high accuracy rate for truths and the low accuracy rate for lies is the result of a 'truth-bias: People's tendency to judge other's messages as being truthful [Levine, Park, & McCornack, 1999; Vrij, 2000]). Although the average hit rate for detecting truths (67%) is reasonably high, it says little about lie detection skills. Good lie detection implies high accuracy rates for both detecting truths and detecting lies. Research has shown that it is possible to detect *both* lies and truths above the level of chance (on average around 70% or above) when conducting polygraph tests (Ekman, 1992; Vrij, 2000) or when using CBCA or RM (Vrij, 2000; Vrij & Akehurst, 1998).

Although observers seem to perform relatively poorly in detecting deceit while paying attention to nonverbal cues compared to detecting deceit by analyzing with CBCA or RM or by measuring physiological responses, we are reluctant to draw any firm conclusions on the basis of such comparisons, as those comparisons are unfair and inappropriate. Studies of detecting deceit via examining physiological responses or via CBCA and RM always include well-trained experts as lie detectors (because they are the only ones who know how to conduct such examinations), whereas lay persons (e.g., college students) are often used as lie detectors in studies involving nonverbal behavior. Some nonverbal behavior studies, however, used professionals such as police officers and customs officers as lie detectors. Although several studies showed that even those professionals perform around the level of chance (DePaulo & Pfeifer, 1986; Köhnken, 1987; Vrij, 1993). Ekman and his colleagues (Ekman & O'Sullivan, 1991; Ekman, O'Sullivan, & Frank, 1999) found that some groups of professionals perform above the level of chance, such as members of the Secret Service and

a group of federal officers with a special interest and experience in deception. The latter group obtained an accuracy rate (truths and lies combined) of 73% (Ekman et al., 1999). However, even these hit rates are within the range of scores reported in the literature for untrained human lie detectors with no special experience (DePaulo, Anderson, & Cooper, 1999).

An explanation why professionals also seem to perform poorly in detecting lies via examining nonverbal behavior is that they do not know where to look and have false beliefs about which behaviors might be clues to deception (Akehurst, Köhnken, Bull, & Vrij, 1996; Vrij & Semin, 1996). Vrij and Semin (1996) found that 75% of professional lie detectors (police officers, customs officers and so on) believe that liars look away, although gaze aversion has not been found to be a reliable indicator of deception (DePaulo et al., 1985; Vrij, 2000; Zuckerman, DePaulo, & Rosenthal, 1981). Research has shown that observers improve their skills in detecting deceit if they receive some information about the relationship between nonverbal behavior and deception. Lie detectors in deTurck's (1991) study obtained an accuracy rate of 70% after they were informed to ignore looking at eye contact but to focus their attention on message duration, response latency, pauses, nonfluencies, adaptors and hand gestures. These accuracy rates are probably still not at their potential level due to the fact that judges do not always use the information with which they are provided. Vrij (1994) informed judges that liars generally display fewer subtle hand and finger movements than truth tellers. He then showed judges videoclips of twenty different people. For each person, two video fragments were presented simultaneously (on two different TV screens located next to each other). In one fragment the person was lying and in the other fragment the person was telling the truth. The judges were asked to indicate for each person in which fragment the person was lying. By consequently using the information provided, 75% of the answers could have been correct. The average accuracy rate, however, was only 60%, suggesting that the judges did not consistently apply the information provided.

It is therefore possible that even higher accuracy rates could be obtained when a more sophisticated nonverbal behavior deception detection method is used, excluding any subjective interpretations. The present experiment examines this issue.

The crucial question is to which behaviors attention should be paid. This question is difficult to answer, as research has shown that deception itself is not related to a unique pattern of specific behaviors (DePaulo et al., 1985; Ekman, 1992; Vrij, 1998, 2000; Zuckerman et al., 1981). In other words, there is nothing like Pinocchio's nose. However, liars might experience emotions while lying. The three most common types of emotion asso-

ciated with deceit are fear, excitement ('duping delight') and guilt (Ekman, 1989, 1992). Liars might be afraid of getting caught, they might become excited at having the opportunity of fooling someone, or they might feel guilty (Ekman, 1992). In some situations, liars also might find it difficult to lie. They have to think of plausible answers, should not contradict themselves, should tell a lie that is consistent with everything the other person knows, should avoid making slips of the tongue, and have to remember what they have said, so that they can say the same things when someone asks them to repeat their story. Experiencing emotions and cognitive load might result in signs of emotion and cognitive load which then gives the lie away (Ekman, 1992; Vrij, 1998, 2000). Experimental studies concerning how people behave under stress have been mainly conducted by Ekman and his colleagues (Ekman, 1992; Frank & Ekman, 1997). They found that under these circumstances it is possible to detect deceit (they reported hit rates around 80%) by paying attention to signs of emotions which emerge via (micro) facial expressions (Frank & Ekman, 1997) or by observing smiles and pitch of voice (Ekman, O'Sullivan, Friesen, & Scherer, 1991). The strongest evidence for the effects of raising the stakes would be obtained by experimentally manipulating the stakes. In a series of experiments conducted by DePaulo and her colleagues in which the stakes were manipulated, it was found that high stake lies were indeed easier to detect than low stake lies (DePaulo, Kirkendol, Tang, & O'Brien, 1988; DePaulo, Lanier, & Davis, 1983; DePaulo, LeMay, & Epstein, 1991; DePaulo, Stone, & Lassiter, 1985b; Lane & DePaulo, 1999). In one of our own recent studies (Vrij, Harden, Terry, Edward, & Bull, in press) this finding was replicated.

The present experiment deals with cognitive load. All participants watched a videotape of a theft in a hospital. In a subsequent interview specific questions about the film were asked. Some participants were requested to recall what they had seen, whereas others were asked to lie without having much time to prepare their lies. The fact that the participants had to lie almost spontaneously makes this task difficult for the liars and we therefore expected liars, compared to truth tellers, to show more behaviors that indicate cognitive load. In particular, we expected liars to show a longer latency period, more 'ah' and 'non-ah' speech disturbances, a slower speech rate and fewer illustrators and hand/finger movements (Hypothesis 1) as these behaviors are associated with thinking hard (Burgoon, Kelly, Newton, & Keely-Dyreson, 1989; Ekman & Friesen, 1972; Goldman-Eisler, 1968; Köhnken, 1989; Vrij, 1998). See the Method section for a description of these behaviors. In order to find out to what extent truth tellers and liars can be correctly classified on the basis of these behaviors,

discriminant analyses were conducted with objective truth status as the classifying variable and these six nonverbal behaviors as independent variables. It was expected that the analysis would reveal an accuracy rate (percentage of correct classifications of truth tellers and liars) above the level of chance (Hypothesis 2).

Differences between liars and truth tellers in what they say are often assessed using Criteria-Based Content Analysis (CBCA) (Ruby & Brigham, 1997; Steller & Köhnken, 1989; Vrij, 2000; Vrij & Akehurst, 1998). CBCA was developed in Germany by Steller and Köhnken (Steller & Köhnken, 1989) in order to evaluate statements from children who are witnesses or alleged victims, most commonly of sexual abuse. Many authors still describe CBCA as a technique solely developed to evaluate statements made by children in sexual offense trials (Honts, 1994; Horowitz, Lamb, Esplin, Boychuk, Krispin, & Reiter-Lavery, 1997). Others, however, advocate the additional use of the technique to evaluate the testimonies of adults who talk about issues other than sexual abuse (Köhnken, Schimossek, Aschermann, & Höfer, 1995; Porter & Yuille, 1996; Ruby & Brigham, 1997; Steller & Köhnken, 1989). In CBCA, trained evaluators examine a statement and judge the presence or absence of each of 19 criteria. Appendix 1 provides a brief description of the CBCA criteria used in this study. Vrij and Akehurst (1998) and Vrij (2000) give more detailed descriptions of the CBCA criteria. The underlying hypothesis of CBCA is that a statement derived from an actual memory of an experience differs in content and quality from a statement based on invention or fantasy, and that only a person who has actually experienced an event is likely to incorporate certain types of content into a statement about it. In other words, the presence of each criterion strengthens the hypothesis that the account is based on genuine personal experience. This hypothesis is originally stated by Undeutsch (1967, 1989) and is therefore known as the *Undeutsch-Hypothesis* (Steller, 1989). Following the Undeutsch-hypothesis, it was expected that liars would obtain lower CBCA scores than truth tellers (Hypothesis 3), and that liars and truth tellers could be correctly classified above the level of chance on the basis of their CBCA scores (Hypothesis 4).

Recently, Reality Monitoring has been used as an alternative method to measure verbal differences between responses believed to be true and false (Alonso-Quecuty, 1992, 1996; Hernandez-Fernaund & Alonso-Quecuty, 1997; Höfer, Akehurst, & Metzger, 1996; Manzanero & Diges, 1996; Roberts, Lamb, Zale, & Randall, 1998; Sporer, 1997). The core of Reality Monitoring is that memories of real experiences are obtained through perceptual processes and are therefore likely to contain *perceptual information* (visual details and details of sound, smell, taste, or physical

sensations), *contextual information* (details about where and when the event took place), and *affective information* (details about how someone felt during the event). Accounts of imagined events are derived from an internal source and are therefore likely to contain *cognitive operations*, such as thoughts and reasonings ('I can only remember my thinking of what my friend would like to have for a present') (Johnson, Hashtroudi, & Lindsay, 1993; Johnson & Raye, 1981, 1998). It was therefore expected that truth tellers would obtain a higher Reality Monitoring score than liars (Hypothesis 5) and would include more perceptual, contextual and affective information in their statements than liars (Hypothesis 6). Liars, on the other hand, are likely to include more cognitive operations in their statements than truth tellers (Hypothesis 7). It was also expected that liars and truth tellers could be correctly classified above the level of chance on the basis of their Reality Monitoring scores (Hypothesis 8).

Finally, it was investigated whether a combination of the two verbal techniques and the nonverbal technique would classify liars and truth tellers more accurately than the individual techniques. We expected this to be the case. A combined technique takes more information into account than do individual techniques, and, the more aspects of liars that will be scrutinized, the more likely it is that their lies can be detected (Hypothesis 9).

Method

Participants

A total of 73 nursing students participated, 20 males and 53 females. Their average age was $M = 28.89$ years ($SD = 7.9$ years). Originally, 79 participants took part in the experiment. Three participants, however, gave answers which lasted less than 10 seconds. As it is impossible to perform CBCA assessments on very short statements, these participants were disregarded in the analyses. Another two participants did not lie when requested to do so and one participant lied when asked to tell the truth. These participants were also disregarded in the analyses.

Procedure

Nursing students were recruited at the University of Portsmouth nursing school. They were asked to participate in a study about "telling lies." Each student participated individually and received £5 for their participation. First of all, in order to motivate the nurses to try to perform well in the

study they were told that the ability to lie successfully is extremely important to nurses and that good nurses may need to be good liars. Previous research has indicated that this information does increase participants' motivation to perform well (DePaulo, Kirkendol, Tang, & O'Brien, 1988; DePaulo, Lanier, & Davis, 1983). They were then told that they would see a video and that they would be interviewed twice about this video. In one interview they had to recall what they had seen and in the other interview they had to lie. The order in which the truthful and deceptive interviews took place was counterbalanced. Only the first interviews (deceptive for some participants and truthful for others) were analyzed, creating a between-subjects design. We introduced the study to the participants as a within-subjects design because we wanted all participants to lie. We did this for motivation purposes: (1) in this case nobody could think that they were allocated to a 'control condition' and (2) the information about the good liar-good nurses relationship was relevant to all participants. The nurses were then shown a video of 118 seconds in length. This videotaped event featured a colour presentation of the theft of a bag from a patient by a visitor. In the video, a woman enters a hospital and walks to the first floor. While walking down the corridor, she notices a patient lying in bed with a handbag next to her. The visitor enters her room, looks at the patient's name plate and pretends that she knows the patient. She then takes the bag and starts to walk out of the room. The patient notices the theft and asks the visitor to return the handbag. A nurse comes in and asks what is going on. The patient tells the nurse that she does not know the visitor and that the visitor is trying to steal her bag. The visitor tells the nurse that she is the patient's neighbour and that the patient is confused. The nurse then leaves the room. The video finishes with the visitor smiling as she opens the patient's purse and notices money in it.

After watching the video, participants in the *truthful condition* ($N = 34$) were asked the following three general and open-ended questions: What did the nurse do? What did the patient do? and What did the visitor do? They were asked to answer all questions truthfully. Participants in the *deception condition* ($N = 39$) were asked to lie while answering the same three questions. In order to make the task not too difficult for the participants they were informed about two of the three questions that would be asked before the interview started and they were given approximately 15 seconds to think about an answer. Which questions were told beforehand was counterbalanced. Analyses showed that this manipulation had no effect on either the verbal or nonverbal behavior displayed by the participants and will therefore be disregarded in this article. All interviews were videotaped and audiotaped and were transcribed verbatim from the audio-

tapes (the transcripts included the stutters made by the participants). The answers of truth tellers were significantly longer ($M = 89$ seconds, $SD = 46$) than the answers of liars ($M = 42$ seconds, $SD = 19$), $F(1, 71) = 34.06, p < .01$).

Dependent Variables

Two observers coded the behavior of the participants independently, and Pearson's correlations were conducted between the two sets of data from the two coders to detect any differences in judgement. The observers were not informed as to whether the participants were lying or telling the truth and had not seen the stimulus video. They employed a coding system used by us in previous studies (Akehurst & Vrij, 1999; Vrij, 1991, 1995; Vrij, Semin, & Bull, 1996; Vrij, Akehurst, & Morris, 1997). The following ten behaviors were coded (the 'ah' and 'non-ah' speech disturbances were scored on the basis of a typed verbatim text):

- gaze aversion*: number of seconds for which the participant looked away from the interviewer (2 coders, $r = .95, p < .01$)
- smiling*: frequency of smiles and laughs (2 coders, $r = .90, p < .01$)
- illustrators*: frequency of arm and hand movements which were designed to modify and/or supplement what was being said verbally (Ekman & Friesen, 1969) (2 coders, $r = .96, p < .01$)
- adaptors*: frequency of scratching the head, wrists etc. Rubbing one's hands together were not coded as adaptors but as hand and finger movements (2 coders, $r = .94, p < .01$)
- frequency of hand and finger movements*: Movements of the hands or fingers without moving the arms (2 coders, $r = .92, p < .01$)
- frequency of foot and leg movements*: Movements of feet or legs. Simultaneous movements of feet and legs were scored as one movement (2 coders, $r = .93, p < .01$)
- speech hesitations*: frequency of saying 'ah' or 'mm' between words (2 coders, $r = .95, p < .01$)
- speech errors*: frequency of word and/or sentence repetition, sentence change, sentence incompleteness, and slips of the tongue (2 coders, $r = .91, p < .01$)
- latency period*: period of time between the question being asked and the answer being given (2 coders, $r = .98, p < .01$)
- speech rate*: number of spoken words (using the count option in WordPerfect) divided by the length of interview minus latency period (2 coders, $r = .98, p < .01$).

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The Pearson's correlations show evidence of a strong consistency between the two coders. Thus, the behavioral scores were based on the average scores of the two coders and are presented in Table 1. The reported duration and frequencies of all categories of nonverbal behavior were corrected for the length of the interviews or for the number of spoken words. Patterns listed from gaze aversion down to foot and leg movements were calculated on a per minute basis. Patterns for ah and non-ah disturbances were calculated per 50 words. Latency period scores represent the average latency period per question. Two independent raters received training in CBCA scoring. First, both raters read all the major published papers about CBCA. Second, they were trained in CBCA scoring by a British CBCA expert. Third, both the trainee raters and the expert rater evaluated several example transcripts (from a different study). Fourth, the three raters compared their results and feedback was given by the expert rater. Following common procedure (Craig, 1995; Hershkowitz, Lamb, Sternberg, & Esplin, 1997; Lamb, Sternberg, Esplin, Hershkowitz, Orbach, & Hovav, 1997; Lamb, Sternberg, Esplin, Hershkowitz, & Orbach, 1997; Landry & Brigham, 1992; Ruby & Brigham, 1998; Vrij, Kneller, & Mann, 2000; Winkel & Vrij, 1995; Zaparniuk, Yuille, & Taylor, 1995) the two observers in the present study scored for each of the three answers the presence or absence of each of the CBCA criteria¹ used in this study, with exception of criterion 3 (quantity of details): '1' was assigned when the criterion was present and '0' when the criterion was absent. Per criterion a total score for the whole interview was calculated by adding the three scores for the three individual answers and then dividing this total score by three. In order to score criterion 3, the raters counted per interview the number of details mentioned. Ratings took place by using the transcripts, and the raters were blind to the experimental conditions. Correlations between the two coders for each of the criteria were satisfactory. They were lower than the correlations with regard to nonverbal behaviors, but higher than found by some others in CBCA research (Anson, Golding, & Gully, 1993): logical structure: $r=.55$, $p < .01$; unstructured production: $r=.65$, $p < .01$; quantity of details: $r=.90$, $p < .01$; contextual embedding: $r=.85$, $p < .01$; description of interactions: $r=.90$, $p < .01$; reproduction of speech: $r=.97$, $p < .01$; unusual details: $r=.77$, $p < .01$; superfluous details: $r=.69$, $p < .01$; accounts of mental state: $r=.58$, $p < .01$; attribution of perpetrator's mental state: $r=.71$, $p < .01$; spontaneous corrections: $r=.54$, $p < .01$; admitting lack of memory: $r=.89$, $p < .01$; raising doubts about one's own memory: $r=.70$, $p < .01$; pardoning the perpetrator: $r=1.00$, $p < .01$. The scores for each of the criteria were therefore based on the average scores of the two coders.

The next step was to calculate a total CBCA score, which is common in CBCA research (Craig, 1995; Esplin, Boychuk, & Raskin, 1988, cited in Raskin & Esplin, 1991; Hershkowitz et al., 1997; Lamb et al., 1997a, b; Vrij et al., 2000; Winkel & Vrij, 1995). In order to calculate the CBCA score, the scores for the 14 criteria were dichotomized. With regard to number of details, a median split ($N = 13.50$) was used. Those 50% of the participants ($N = 37$) with a score higher than 13.50 obtained '1' on this criterion, the other 50% obtained a score of '0.' Dichotomizations for the other criteria occurred on the basis of presence or absence of a criterion in the whole interview. A score of '0' was assigned when the criterion was absent, and a score of '1' was assigned when the criterion was present. The total CBCA score was the total score of the 14 criteria and could range from 0 to 14.

Two independent raters received training in RM-scoring. A British RM-expert provided the judges with a detailed description of how the criteria should be scored, including some case examples. On the basis of this information the judges felt capable of scoring the transcripts without any further instructions. This is in agreement with Sporer (1997) who also found that it is much easier to teach (and to learn) Reality Monitoring scoring than CBCA scoring. With regard to the present study, the two raters scored per interview the frequency of occurrence of visual details (which includes actions) ("The visitor^a came in^b and kissed^c the patient^d are four visual details (a, b, c, and d), sound details ("She said that is my bag" is one sound detail), time details ("When the nurse came in, the patient . . ." is one time detail), details about location ("The visitor walked through the corridor" is one location detail), and cognitive operations ("the patient didn't believe she knew the visitor" is one cognitive operation). Affective information is similar to CBCA criterion 12 (accounts of subjective mental state) and therefore was not scored again, the CBCA score for this criterion being used in the Reality Monitoring scores. Ratings took place using the transcripts and the raters were blind to the experimental conditions. Inter-coder reliability scores (Pearson's correlations) were calculated for all the individual criteria (visual details: $r = .96$, $p < .01$; sound details: $r = .77$, $p < .01$; details about location: $r = .72$, $p < .01$; time details: $r = .85$, $p < .01$; cognitive operations: $r = .75$, $p < .01$). The correlations showed consistency amongst the two coders and scores for each of the criteria were therefore based on the average scores of the two coders. Table 2 provides the results for the individual Reality Monitoring criteria. In order to create the Reality Monitoring scale each variable was dichotomized. A median split ($N = 10.50$) was used for visual details. Those 50% of the participants with a score higher than 10.50 obtained '1' on this criterion,

the other 50% obtained a score of '0'.² Dichotomizations for the other criteria occurred on the basis of absence or presence of each of the criteria in the interview. A score of '0' was assigned when the criterion was absent, and a score of '1' when the criterion was present. Cognitive operations were not included in the total Reality Monitoring score as the presence of this criterion does not indicate truth telling (as is the case with the other criteria). The Reality Monitoring scale therefore contained five criteria (visual details, sound details, details about locations, details about time and affective information) and the total score could range from 0 to 5.

Results

In order to test Hypothesis 1 (liars display a longer latency period, more ah and non-ah speech disturbances, a slower speech rate and fewer illustrators and hand/finger movements than truth tellers), Hypothesis 3 (truth tellers will obtain a higher CBCA score than liars) and Hypothesis 5 (truth tellers will obtain a higher RM score than liars) a MANOVA was conducted with Deception (yes or no) as factor and the nonverbal behaviors, total CBCA score and total RM score as dependent variables. The MANOVA revealed a significant effect, $F(12, 60) = 5.11, p < .01$. Table 1 provides the univariate outcomes. As can be seen in Table 1, several significant differences emerged between liars and truth tellers. Compared to truth tellers, liars made fewer illustrators and hand and finger movements, had more ah-speech disturbances, and waited longer before giving an answer. These findings support Hypothesis 1. Furthermore, truth tellers obtained a higher CBCA score³ and a higher RM score than liars. Therefore, Hypotheses 3 and 5 are also supported.

In order to test Hypothesis 6 (truth tellers will include more perceptual, contextual and affective information in their statements than liars) and Hypothesis 7 (liars are likely to include more cognitive operations in their statements than truth tellers) a MANOVA was conducted with Deception (yes or no) as factor and the individual (not dichotomized) Reality Monitoring criteria as dependent variables. The MANOVA showed a significant effect, $F(5, 67) = 9.61, p < .01$. Table 2 gives the results for the individual Reality Monitoring criteria. As can be seen in Table 2, truth tellers included more perceptual details (vision and sound), more information about locations and more information about time in their accounts than liars. This supports Hypothesis 6. In contrast to what was predicted in Hypothesis 7, liars mentioned fewer cognitive operations than truth tellers.

In order to test Hypotheses 2, 4, 8 and 9, four discriminant analyses

TABLE 1

Nonverbal Behavior as a Function of Deception

| Behavior | Condition | | | | F(1, 71) |
|----------------------------|-----------|--------|--------|--------|----------|
| | Truth | | Lie | | |
| | m | (sd) | m | (sd) | |
| gaze aversion | 4.66 | (6.5) | 6.33 | (8.2) | .91 |
| smiles | .66 | (1.0) | 1.66 | (3.1) | 3.24 |
| illustrators | 6.74 | (8.1) | 1.64 | (5.0) | 10.86** |
| adaptors | 1.97 | (3.8) | .86 | (3.0) | 1.93 |
| hand/finger movements | 15.73 | (13.7) | 9.17 | (13.0) | 4.42* |
| foot/leg movements | 11.62 | (9.7) | 13.78 | (16.9) | .43 |
| ah speech disturbances | 2.73 | (2.7) | 4.64 | (3.4) | 7.00** |
| non-ah speech disturbances | .98 | (1.8) | 1.62 | (2.3) | 1.73 |
| latency period | 2.24 | (1.4) | 3.65 | (4.3) | 5.73* |
| speech rate | 130.23 | (49.4) | 142.11 | (64.3) | .76 |
| CBCA | 5.32 | (2.0) | 3.31 | (1.5) | 23.44** |
| RM | 3.20 | (1.3) | 2.00 | (1.1) | 14.58** |

** p < .01; * p < .05.

** $p < .01$; * $p < .05$.

were conducted determining the accuracy of the detection techniques in classifying liars and truth tellers. In these analyses, the objective truth status was the classifying variable and the six nonverbal behaviors mentioned in Hypothesis 1, total CBCA score and total RM score were the independent variables. The results are given in Table 3. First of all, it can be seen that the analysis with nonverbal behaviors as variables yielded a highly significant discriminant function, $\chi^2(4, n=73) = 23.57, p < .01$. Four variables contributed to this function: Illustrators (Wilks' lambda = .87), ah speech disturbances (Wilks' lambda = .78), hand and finger movements (Wilks' lambda = .73), and latency period (Wilks' lambda = .71). In total, 70.6% of the truth tellers and 84.6% of the liars were correctly classified resulting in a total accuracy score of 78.08%. This supports Hypothesis 2.⁴ Also the discriminant analyses with the total CBCA scores and RM scores as variables resulted in highly significant discriminant functions (see Table 3) and correct classifications of the majority of participants (72.60% with CBCA and 67.12% with RM respectively). This supports Hypotheses 4 and 8.

TABLE 2

Reality Monitoring Criteria as a Function of Deception

| Criteria | Condition | | | | F(1, 71) |
|--------------------------------|-----------|-------|------|-------|----------|
| | Truth | | Lie | | |
| | m | (sd) | m | (sd) | |
| Perceptual information: vision | 13.13 | (6.3) | 9.45 | (3.7) | 9.39** |
| Perceptual information: sound | 3.31 | (2.2) | 1.26 | (1.4) | 22.88** |
| Spatial information | 2.03 | (2.1) | 1.30 | (1.2) | 3.53* |
| Temporal information | 1.35 | (1.4) | .28 | (.7) | 18.57** |
| Cognitive operations | 3.32 | (2.1) | 1.71 | (1.7) | 12.88** |

** p < .01; * p < .05.

** $p < .01$; * $p < .05$.

The fourth discriminant analysis revealed that, as was predicted in Hypothesis 9, the combination of the two verbal techniques with the nonverbal technique resulted in the highest accuracy scores, in particular a higher accuracy rate for detecting truths was obtained. In that case, 76.5% of the truth tellers and 84.6% of the liars were correctly classified, resulting in a total accuracy score of 80.82%. The discriminant function was highly significant, $\chi^2(6, n=73) = 38.79, p < .01$. Six variables contributed to this function: CBCA score (Wilks' lambda = .74), latency period (Wilks' lambda = .67), hand and finger movements (Wilks' lambda = .63), ah-speech disturbances (Wilks' lambda = .60), illustrators (Wilks' lambda = .58) and speech rate (Wilks' lambda = .57).

Discussion

Previous research has created a pessimistic view about the possibility of detecting lies by analyzing nonverbal behavior. We argued that it might be possible to detect lies when the appropriate behaviors are taken into account and subjective interpretations are disregarded. We defined appropriate behaviors as signs of emotion or signs of cognitive load. As mentioned in the introduction, DePaulo's work revealed that high stake lies are easier to detect than low stake lies, and Ekman's work showed that up to 80% of truths and lies can be detected in high stake situations while paying attention to behavioral signs of emotion. Our findings revealed similar high per-

TABLE 3**Discriminant Analyses with Nonverbal Behavior, Criteria-Based Content Analysis and Reality Monitoring**

| Detection technique | Hit rates | | | Eigenvalue | Lambda | df | χ^2 |
|--------------------------------|-----------|-------|--------|------------|--------|----|----------|
| | Truth | Lie | Total | | | | |
| Nonverbal behavior | 70.6% | 84.6% | 78.08% | .41 | .71 | 4 | 23.57** |
| CBCA | 64.7% | 79.5% | 72.60% | .35 | .74 | 1 | 20.91** |
| RM | 70.6% | 64.1% | 67.12% | .25 | .80 | 1 | 13.17** |
| CBCA + RM + nonverbal behavior | 76.5% | 84.6% | 80.82% | .77 | .57 | 6 | 38.79** |

** p < .01; * p < .05.

centages of accurately detecting truths and lies in situations which require hard thinking while taking signs of cognitive load into account.⁵ The findings suggest that, if properly applied, analyzing nonverbal behavior might be an accurate tool to detect deceit.

The liars in this study were facing a difficult task. They had to make up a story (had to tell a so-called 'bold-faced lie' [McCornack, 1997]) and had to do this almost spontaneously. It is therefore perhaps not surprising that they showed signs of cognitive load. To what extent are these bold-faced lies realistic? McCornack (1997) argues that bold faced lies comprise only a small portion of the deceptive messages and that most deceptive messages in daily life involve subtle and complex packaging of both false and truthful elements. We have no reason to dispute this view, but would like to emphasize that bold-faced lies do occur in daily life settings. They also take place in police interviews. For example, in our analysis of police interviews with a convicted murderer (Vrij & Mann, in press) we came across a bold-faced lie, which is related to how he met the victim. Substantial evidence (several independent eye witnesses and physical evidence) has shown that he went to *location A* and that *he made contact with the victim*. He strongly denied this and told the police instead that he met the victim at *location B* (which was totally different from location A) and that *the victim approached him*. He described in detail how the victim contacted him, a story which was entirely fabricated. Another of our studies (Vrij & Mann, in press, b) involved two more apparently bold-faced lies. In one case, a man who was found guilty of the murder of his wife claimed that people forced themselves into his house, killed his wife, beat him until he was unconscious and tied him up. He had several injuries which, he claimed, were the result of the attack. The man, however, had injured himself in an attempt to make his story more plausible. In another case, a woman who was found guilty of killing her boyfriend told the police that they were the victims of road rage and that a stranger chased their car and eventually killed her boyfriend. All these seem to be examples of bold-faced lies. One might argue that even bold-faced lies are often not total fabrications as people, when fabricating a story, could simply describe a situation they had experienced before. It is unlikely that the liars in the present study could do this, as they were forced to fabricate about a specific situation, namely the activities of a patient, nurse, and visitor in a hospital. We acknowledge that some bold-faced lies are probably not total fabrications, but we believe that some are. For example, had the woman ever experienced a road rage event in her life before? Similarly, was the man beaten until unconscious and tied up in his life before? We do not know the answers

to these questions but their stories might well have been total fabrications.

We instructed the liars in our study to tell total fabrications not because we are particularly interested in this type of lie, but because we wanted to create a situation in which the lie requires mental effort. We acknowledge that in real life telling lies often does not require more mental effort than telling the truth. McCornack (1997, p. 102) convincingly argued that deception possesses fundamental cognitive efficiency advantages over truth telling within certain contexts. For example, by receiving a present which you do not like from an acquaintance it is often easier to lie and to say that you like the present than to express your true opinion. We believe that in real life some lies do require mental effort, as our own study with the convicted murderer revealed (Vrij & Mann, in press, a). When the police interviewed him the first time, he was asked 'What did you do on that particular day?' He described his activities in detail and in chronological order but his behavior changed as soon as he started to describe his activities during the afternoon. The police later discovered that he lied in that part of the interview. While lying, the man showed more gaze aversion, had longer pauses, spoke slower and made more speech errors than when he was telling the truth. This behavioral pattern is typical for somebody who has to think hard. Perhaps it was surprising that the man gave the impression that he had to think hard. As he told the police, he knew he was a suspect in this case and expected to be interviewed. There is also evidence that he had prepared himself for the police interviews. A possible explanation is that he was not very bright, thus not fully taking advantage of the preparation time that was available to him. As Ekman and Frank (1993) have pointed out, preparation probably does not benefit liars who are not so clever. If intelligence really affects preparations, then criminals or guilty suspects might be in a disadvantageous position during police interviews as their IQ is often rather low (Gudjonsson, 1992).

It also might explain the preliminary findings of our current analyses of interviews with suspects in police interviews (Mann, Vrij, & Bull, 1998). They reveal that when suspects lie they show a decrease in illustrators, an increase in pauses and an increase in latency period. In other words, suspects seem to show signs of cognitive load. In our view, systematic and detailed analyses of nonverbal behavior displayed by suspects and looking for signs of cognitive load are therefore useful to detect deceit.

Obviously, signs of cognitive load per se do not necessarily indicate deception, as truth tellers might have to think hard as well. Detecting deceit by paying attention to nonverbal behavior in real life settings is a two stage process (Vrij, 2000). First, signs of emotion (guilt, fear, excitement or

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any other emotion) or cognitive load need to be detected and, second, explanations for these signs should be given, where deceit is only one possible explanation. This process may reveal lies. As was mentioned above, the convicted murderer changed his behavior as soon as he started describing his activities during the afternoon (Vrij & Mann, in press, a). We wondered why and hypothesized that he was lying at that particular moment. Our intuition turned out to be correct.

In theory it is possible that in the present experiment the behavior of an extraordinary sample of people was examined whose lies are easy to detect. There is evidence that this was not the case. In a recent study (Vrij & Baxter, 1999), we randomly selected fragments of 10 interviews out of the 73 interviews analyzed in the present study and showed these interviews to 50 college students. We asked the students to indicate for each person in the interview whether the person was lying or not. The students achieved an accuracy rate of 56% for truths and 50% for lies. These outcomes are typically found in this type of detection of deception experiment.

The results of the present experiment further revealed that accuracy rates above the level of chance were obtained with both CBCA assessments and Reality Monitoring assessments. It is difficult to make a comparison of both methods at this stage. CBCA might well have been in a disadvantageous position in this comparison, as it was used in a context other than the one for which it was designed. As stated earlier, CBCA was originally designed for assessing statements of children in sexual abuse cases. In this study it has been used to assess adults' statements. Some researchers have advocated the use of the CBCA technique to also evaluate the testimonies of adults who talk about issues other than sexual abuse. The reasonably high accuracy rate obtained in the present study (72.6%) support their view. Reality Monitoring might have been in a disadvantageous position as well. One important aspect of Reality Monitoring is looking for perceptual information, such as cues of sound, vision, smell, taste or touch. As participants did not actually take part in an event—they were only watching a videotape—they could not smell, taste or touch anything (and therefore did not mention any of these cues). Finally, the comparison of both verbal methods was not entirely fair because accounts of mental state were counted only under CBCA. These scores were then added in the Reality Monitoring lie detection scale as well. CBCA was hereby given a potential advantage.

A logical step is to combine both verbal methods. An interesting addition to the CBCA list of criteria would be the Reality Monitoring criterion 'perceptual information' (criterion 2). For example, pornographic films may

increase children's knowledge about sexual acts. As a result, an unexperienced child may give a detailed account about a non-experienced sexual encounter after watching a pornographic film. However, in such a recall details about smell and taste will be missing, as genuine experiences are required for such details. Details about smell and taste in statements about sexual abuse may therefore be a strong indication that the statements are based upon real experiences (unless smell and taste were mentioned by people in the pornographic film).

There was no support for Hypothesis 7 which suggested that liars would include more cognitive operations in their accounts than truth tellers. Previous deception research with Reality Monitoring also could not support this hypothesis (Alonso-Quecuty, 1992, 1996; Hofer et al., 1996; Roberts et al., 1998; Sporer, 1997). One explanation is that people use cognitive operations in order to facilitate and enhance later memory for experienced events (Roediger, 1996). For example, a person who drove fast in Germany might try to remember this in two different ways. First, the person could remember having actually looked at the speedometer to find out how fast he or she was driving. Alternatively, they could remember this by logical reasoning, for example, by thinking that he or she must have driven fast because they used the motorway. The latter alternative, in which a cognitive operation is included, is an easier way of remembering having driven fast than the first alternative. When the person is asked a couple of years later whether he or she drove fast through Germany it is therefore more likely that the person will remember this by thinking that he or she drove on the motorway than by remembering having checked the speedometer. As a result, the person's memory about this experienced event will contain a cognitive operation. Due to the lack of support for cognitive operations found in the present and previous studies, we suggest this variable should not be included in a Reality Monitoring lie detection scale. As was mentioned in the method section, cognitive operations was not included in the Reality Monitoring scale in the present study either. Including this variable in the Reality Monitoring scale and rerunning the discriminant analysis led to a significant discriminant function ($\chi^2(1, n = 73) = 8.53, p < .01$, eigenvalue = .13, Wilks' Lambda = .89) but to lower hit rates (truth: 70.6%, lie: 53.8%, total: 61.64%) than the hit rates obtained without cognitive operations (see Table 3).

Although previous studies suggest that verbal cues (CBCA and RM) are more powerful discriminators between truths and lies than nonverbal cues (see introduction), such studies typically do not compare verbal cues and nonverbal cues directly, making it impossible to determine the relative power of both sets of discriminators. Such a direct comparison was made

in the present experiment. Interestingly, the present findings did not show superiority of verbal cues above nonverbal cues. However, we acknowledge that more research needs to be done. Such studies should incorporate different types of lie.

Instead of comparing verbal and nonverbal detection methods, in our view a more fruitful approach would be to investigate to what extent a combination of verbal and nonverbal detection methods lead to higher accuracy rates than the two types of method independently. The present study showed that the highest accuracy rates were obtained by combining the verbal and nonverbal techniques. The discriminant analysis that took all three techniques into account could correctly classify 80.82% of the liars and truth tellers and both verbal (CBCA) and nonverbal cues contributed to the significant discriminant function. Some Reality Monitoring researchers (Porter & Yuille, 1996; Roberts et al., 1998) already use a combined instrument by including speech disturbances in their Reality Monitoring scale. Our findings support this idea. In the discriminant analysis in which the three techniques were included, both speech disturbances and verbal cues (CBCA score) contributed to the discriminant function. The discriminant function, however, revealed that in addition to speech disturbances, behaviors such as illustrators, hand and finger movements, and latency period made an important contribution to detecting deceit as well. We therefore recommend to also take behaviors other than speech disturbances into account when attempting to detect deceit.

Concerning the methodology of the study, one issue merits attention. All participants watched the same 2 minute video of a theft in a hospital. It might be that the truths told by the participants bore more similarity to one another than the lies they told. On the basis of this, it might be that a coder could probably tell after a few trials of coding which narrative they were coding were probably truthful and which were lies. This 'knowledge' might have affected their codings. Although this sounds reasonable, we do not think that this actually happened, as the stories of truth tellers did not show too much similarity. Some truth tellers used a 'global approach' and just mentioned in a few sentences what, in their view, were the main events in the video. However, different truth tellers who applied this approach phrased the events differently and mentioned different events. Other truth tellers used a more detailed approach and discussed the video in more detail. Even in this situation the stories of different truth tellers varied, as different truth tellers mentioned different details.

With regard to the ecological validity of the present study, probably the most obvious criticism is that we asked our participants to describe an event they had watched on a video rather than describing a live event in

which they had actually participated. There were two reasons why we chose a videotaped event. First, we wanted to create a highly controlled and standardised situation. We believe that it is essential to test innovative ideas (such as comparing different detection of deception techniques) in highly controlled situations first, as the exact impact can only be determined in such situations. Second, recent research has shown that watching an event on a video or actually taking part in such an event results in similar CBCA scores (Akehurst, Köhnken, & Höfer, 1995). This suggests that a method utilizing a videotaped event has a positive effect on the standardization of the study without compromising its ecological validity too much. Despite this, we do acknowledge that deception research should also include studies with higher ecological validity than that of the present study.

Appendix 1:

A Brief Description of the CBCA Criteria Used in This Study

1. Logical structure. Logical structure is present if the statement essentially makes sense, that is, if the statement is coherent and logical and the different segments fit together, that is, for example different segments are not inconsistent or discrepant. *2. Unstructured production.* Unstructured production is present if the information is scattered throughout the statement instead of mentioned in a structured, coherent and chronological order. The incoherent and unorganized manner of presentation is, for instance, caused by digressions or spontaneous shifts of focus. *3. Quantity of details.* This criterion requires that the statement must be rich in detail, that is, specific descriptions of place, time, persons, objects and events should be present. *4. Contextual embedding.* Contextual embedding is present if the events are placed in time and location, and when the actions are connected with other daily activities and/or customs. *5. Descriptions of interactions.* This criterion is fulfilled if the statement contains information about interactions involving at least the accused and witness, and if this information consists of three parts, i.e. an action of actor A leads to a reaction of actor B which leads to a reaction of actor A again. *6. Reproduction of speech.* Reproduction of speech is present if speech, or parts of the conversation, is reported in its original form and if the different speakers are recognizable in the reproduced dialogues. This criterion is not satisfied by a report about the content of a dialogue; it is only satisfied when there is a virtual replication of the utterances of at least one person. *8. Unusual details.* Unusual details refer to details of persons, objects, or events which

are unusual and/or unique but meaningful in the context. 9. *Superfluous details*. Superfluous details are present if the witness describes details in connection with the allegations which are not essential for the accusation, such as a child who says that the adult tried to get rid of the cat which entered the bedroom because he (the adult) is allergic to cats. 12. *Accounts of subjective mental state*. This criterion is present when the witness describes feelings or thoughts experienced at the time of the incident, as well as reports of cognitions, such as thinking about how to escape while the event was in progress. 13. *Attribution of perpetrator's mental state*. This criterion is present if the witness describes her or his perceptions of the perpetrator's feelings, thoughts or motives during the incident. 14. *Spontaneous corrections*. This criterion is fulfilled if corrections are spontaneously offered or information is spontaneously added to material previously provided in the statement (spontaneous means without any interference by the interviewer). 15. *Admitting lack of memory*. This criterion is present if a witness admits lack of memory by either saying "I don't know" or "I don't remember" or by giving a more extensive answer. 16. *Raising doubts about one's own testimony*. This criterion is present if the witness expresses concern that some part of the statement seems incorrect or unbelievable. 18. *Pardoning the perpetrator*. Pardoning the perpetrator is present if the witness tends to favour the alleged perpetrator in terms of making excuses for the alleged perpetrator or failing to blame the alleged perpetrator.

Notes

1. Given the fact that in this study statements of *adults* were used, we thought that several criteria would be inappropriate and were therefore ignored. These criteria were: accurately reported details misunderstood (criterion 10), related external associations (criterion 11) and details characteristic of the offense (criterion 19). Unexpected complications (criterion 7) and self deprecations (criterion 17) were initially scored but were never present. They were therefore disregarded, leaving a total of 14 CBCA criteria to be assessed.
2. The number of details in the Reality Monitoring scoring differed from the number of details in the CBCA scoring because different definitions are used in both coding systems. For example, "The young nurse . . ." results in two details in CBCA scoring and in one detail in Reality Monitoring scoring.
3. A MANOVA was conducted examining differences between liars and truth tellers with regard to the 14 individual CBCA criteria used in this study. The MANOVA, which was performed on the original, not dichotomized data, showed a significant main effect, $F(14, 58) = 4.74, p < .01$. Univariate tests revealed that compared to liars, truth tellers included more details ($M = 21.25$ ($SD = 8.5$) vs $M = 11.30$ ($SD = 4.1$), $F(1, 71) = 42.59, p < .01$), more contextual embeddings ($M = .18$ ($SD = .2$) vs $M = .09$ ($SD = .1$), $F(1, 71) = 3.92, p < .05$), more reproductions of conversations ($M = .20$ ($SD = .2$) vs $M = .09$, ($SD = .1$), $F(1, 71) = 4.75, p < .05$), more unusual details ($M = .07$ ($SD = .1$) vs $M = .00$ ($SD = .0$), $F(1, 71) = 9.02, p < .01$), more accounts of other's mental state ($M = .49$ ($SD = .3$) vs $M = .23$ ($SD = .3$), $F(1, 71) = 15.83$,

- $p < .01$, and more spontaneous corrections ($M = .23$ ($SD = .2$) vs $M = .11$ ($SD = .2$), $F(1, 71) = 5.74$, $p < .05$).
4. It is important to note that it is the combination of nonverbal behaviors that is powerful, not any one individual behavior. Illustrators obtained a high individual hit rate (69.86%, eigenvalue .15, Wilks' lambda = .87, $\chi^2(1, n = 73) = 10.03$, $p < .01$). However, a distinction between truths and lies resulted in a high hit rate for lies (89.7%) but a particularly low hit rate for truths (47.1%).
 5. We assume that our findings are caused by cognitive load. However, as we did not experimentally manipulate cognitive load in this study, we cannot say this for certain.

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RESEARCH ARTICLE

Good Liars Are Neither 'Dark' Nor Self-Deceptive

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Abstract

Deception is a central component of the personality 'Dark Triad' (Machiavellianism, Psychopathy and Narcissism). However, whether individuals exhibiting high scores on Dark Triad measures have a heightened deceptive ability has received little experimental attention. The present study tested whether the ability to lie effectively, and to detect lies told by others, was related to Dark Triad, Lie Acceptability, or Self-Deceptive measures of personality using an interactive group-based deception task. At a group level, lie detection accuracy was correlated with the ability to deceive others—replicating previous work. No evidence was found to suggest that Dark Triad traits confer any advantage either to deceive others, or to detect deception in others. Participants who considered lying to be more acceptable were more skilled at lying, while self-deceptive individuals were generally less credible and less confident when lying. Results are interpreted within a framework in which repeated practice results in enhanced deceptive ability.

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Introduction

Many studies have shown humans to be relatively poor lie detectors, performing little better than chance at discriminating truthful from deceptive statements [1,2]. Despite the poor performance of the average individual, some authors claim substantial individual differences, such that some people are capable of detecting deception at levels far above chance (e.g. the 'Wizards Project' of O'Sullivan & Ekman, [3]; c.f. Bond & DePaulo, [2]). This claim has prompted a series of studies aiming to elucidate the factors which may determine deception detection ability. The results of these studies are fairly conclusive; of the characteristics studied (age, occupation, education or gender), none seem to consistently co-vary with the ability to detect lies (see meta-analyses [4,2]).

Recent research from our own lab suggests that lie detection ability may be associated with lie production ability—a deception-general ability. Using an interactive paradigm (the **Deceptive Interaction Task 'DeceIT'** [5]), we found that participants able to successfully deceive others were also able to successfully detect others' attempts to deceive. However, this result

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requires replication, as it stands in contrast to two earlier studies which, using non-interactive tasks, found no relationship between lie production and detection [6,7].

Importantly, relatively few studies have examined predictors of the ability to *produce* successful lies. This is surprising as the success or failure of any deceptive interaction may be more attributable to the performance of the liar than that of the lie detector [8]. A meta-analysis by Bond and DePaulo [2] suggested that individuals vary more in terms of the detectability of their lies rather than in their ability to detect deception, and vary maximally in terms of their general credibility (or Demeanour Bias; [9]).

Despite limited experimental attention, it is often assumed that there exists an association between the 'Dark Triad' and deceptive ability, with those scoring higher on Dark Triad measures demonstrating increased ability to deceive others. The Dark Triad is a cluster of three higher-order personality constructs (Machiavellianism, Psychopathy and Narcissism), which are moderately inter-correlated, but which are nevertheless considered to be distinct [10]. The Dark Triad is stable over time, observed across various regions of the world [11], and is moderately heritable (with heritability estimates between .31 and .72; [12]).

The Dark Triad has been associated with numerous antisocial tendencies related to deceit (e.g. [13,14,15]). Machiavellians prioritise the attainment of money and power [16], and have been described as preferentially adopting deceitful and duplicitous behaviour in order to gain dominance [17]. This preference for deceptive strategies is supported by diary studies in which Machiavellians report telling more lies than those low in Machiavellianism [18]. However, experimental studies of the relationship between deceptive ability and Machiavellianism have produced mixed results. An early study by Exline, Thibaut, Hickey, and Gumpert [19] found that high Machiavellians were able to lie more convincingly than low Machiavellians. Five further studies, however, failed to show the same pattern of results [20]. DePaulo and Rosenthal [6] used a video-based deception task and found that high Machiavellian individuals were less likely to be caught lying than low Machiavellian individuals, but this result was not replicated by Manstead, Wagner and MacDonald [7]. In the only study also to look at lie detection ability, Geis and Moon [21] found that high Machiavellians were better able to lie than low Machiavellians, and were rated as more credible, but did not show enhanced lie detection abilities. A meta-analysis of this mixed literature found no evidence for enhanced deceptive skill in high-Machiavellian individuals [22].

The second Dark Triad trait, psychopathy, has been argued to be the prototypical syndrome for pathological lying, deception, and manipulation [23,24,25,26], with psychopaths deriving particular satisfaction from deceit [25,27]. There have not been many empirical studies of the association between deception production abilities and psychopathy, but the existing literature suggests that although psychopaths report a higher ability to deceive others than non-psychopaths, this may not be an accurate reflection of reality [28,29]. In addition, no relationship was found between psychopathy and the ability to detect deception [25,30] although in the latter study the correlation between deception detection and psychopathic traits approached significance.

Narcissism is not associated with deception as commonly as the rest of the Dark Triad traits. Narcissists are competitive, seek power and glory, and exhibit a grandiose sense of self. Their grandiose sense of self is maintained in the face of negative/realistic feedback through self-deception [31,32,10,33,34]. The ability to successfully self-deceive has been argued to bring about a greater ability to deceive others (see Trivers, [35,36]). Indeed, Trivers [36] has argued that the reason why humans have evolved the capacity to self-deceive is precisely because it aids in the deception of others; if the liar is unaware that they are lying it is less likely that they will exhibit any deceptive 'cues'. However, whether narcissists do indeed have greater deceptive ability than non-narcissists has not been investigated empirically.

This study aims to examine the relationship between deceptive ability (both production and detection) and the Dark Triad, including associated measures of lie acceptability and self-deception. The overall aim is to determine whether any of these measures can predict performance when producing or detecting deceptive statements. The use of the DeceIT procedure allows these individual difference variables to be tested against success in the detection and the production of deceptive statements, and also against measures of general credibility and credibility (or truth bias) through the use of signal detection theory [37] applied to performance in both the Sender and Receiver roles as originally presented in [5] and detailed in [38].

Method

Participants

75 healthy adult participants (28 male, 47 female, Mean age = 27.25 years, SD = 7.59) took part in a computer-administered competitive interactive group deception task (DeceIT—Wright et al., 2012 [5]). Participants were fluent English speakers and all provided written informed consent to participate. The procedure received ethical approval from the Birkbeck Psychological Research Ethics Committee.

Materials and apparatus

Prior to the task, participants completed questionnaires assessing Machiavellianism, sub-clinical Narcissism and sub-clinical Psychopathy. These were: the MACH-IV [20], the Narcissistic Personality Inventory Short-Form (NPI-16) [39] and the Sub-Clinical Self-Report Psychopathy Questionnaire Short-Form (SRP-SF) [40]. Participants also completed the Self-Deception Scale of the Balanced Inventory of Desirable Responding [41] as used by Lynch & Trivers [42] to measure self-deception, and the Lie Acceptability Scale [43] which measures the extent to which an individual considers deceit to be an acceptable strategy to achieve personal goals.

As per the original DeceIT task detailed in [5] a False-Opinion Paradigm was employed [44,45]. Ground truth was initially obtained by presenting a “Social Opinion Questionnaire” which comprised a series of ‘For or Against’ questions relating to topical issues that had recently featured in mainstream media such as Censorship of the Media and Nuclear Power.

In a development from its earlier implementation, the DeceIT paradigm was administered on 9-inch tablet PCs. The underlying procedure (see below) was otherwise identical to the original DeceIT task [5]. Experimental instructions and stimulus material were presented on the tablet PCs, which were positioned for ease of viewing and were not visible to other players. Participant responses in each trial were prompted on screen and collected via touchscreen responses.

Procedure

Participants were recruited in groups of five to a “Communication Skills Experiment”. Participants were seated in a circle of five chairs with integral writing platforms. The participants were identified by numbers from one to five and informed that they would be referred to by number only to maintain confidentiality.

The deceptive interactive task (DeceIT) required participants to take turns making true or false statements on the opinion topics previously surveyed using the Social Opinion Questionnaire. Upon a cue presented on the tablet screen, the participant randomly allocated to the Sender role for the current trial was informed of the topic (e.g. Animal Testing) and the veracity of the statement required (lie or truth). All those allocated to the Receiver role (i.e. those required to judge the veracity of the statement) were told to attend to a specified participant by

number. The statements were made verbally and participants were instructed to speak as soon as they were ready for between 20 and 30 seconds. At the end of the statement, Senders were asked to rate the perceived credibility of the statement they had just made. The four participants not randomly allocated to the Sender role on each trial (i.e. those in the Receiver role) were instructed to judge whether the Sender was making a true or false statement.

The experimental trials continued with quasi-random allocation of topics and of the Sender role until each participant had made both truthful and deceptive statements on each of the 8 opinion topics, resulting in 80 live trials per participant group. High-value incentives (£50 monetary prizes) were offered to the best performers in the Sender and Receiver roles. In order to accurately measure credibility, it was made clear to participants that to be as successful as possible in the Sender role they should be as credible as possible on every trial—and that trying to appear as if they were lying when telling the truth would be a counter-productive strategy.

Prior to the DeceIT task all participants observed the experimenter perform two demonstration trials to the group as a whole (reading out verbatim responses from previous iterations of the task), and ran through two practice trials (one of which required them to lie, and one to tell the truth) without speaking aloud. At the end of the task, participants rated their Guilt, Anxiety and Cognitive Load (described as mental effort in the rubric) in both experimental conditions on 7 point Likert scales with end points labelled 'not at all' to 'extremely'.

Data collection and analysis strategy

Performance in the Receiver and Sender roles was analysed using a Signal Detection Theory framework (SDT) [37] as previously described in Wright et al. [5]. Performance in both Receiver and Sender roles is indexed using lie-truth differential performance (d') measured independently of bias (C). Separate SDT measures were calculated for the Receiver/Sender roles: the Receiver's capacity to discriminate lies from truths is indexed by d'_{Receiver} ; the corresponding measure of bias, C_{Receiver} , corresponds to Truth Bias (with negative values indicating the tendency to judge statements as truthful regardless of veracity, while a positive value indicates a bias to classify messages as lies). The discriminability of the Sender's truths and lies is indexed by d'_{Sender} . The corresponding measure of bias, C_{Sender} , indicates the perceived overall credibility of a Sender, regardless of their veracity, and is often termed 'Demeanour Bias' within the deception literature—negative scores indicating higher credibility and positive scores indicating lower credibility. With these measures, better lie detection is indicated by higher d'_{Receiver} values, and increasingly successful deception (relative to success when telling the truth) is indicated by more negative values of d'_{Sender} .

Results

Dark Triad measures

Broad variability in all Dark Triad measures was observed, with 31 individuals (41% of sample) being identified as "high-Machiavellians". Recommended cut-off scores for Narcissism and Psychopathy are not available given the sub-clinical usage of the instruments employed. In line with previous research [10] moderate correlations were found between all Dark Triad components ranging from .247 to .349 (all $p < .05$, see Table 1 below). In addition, a significant positive correlation was observed between Machiavellianism and Lie-Acceptability (.384, $p = .001$) and, between Narcissism and Self-Deception (.259, $p = .025$).

Table 1. Table of correlations between Machiavellianism, Narcissism, Psychopathy, Composite Dark Triad, Lie Acceptability, Self-Deception and the four SDT-derived performance measures in the DecelT task.

| | Machiavellianism | Narcissism | Psychopathy | Lie Acceptability | Self-Deception |
|------------------------|-------------------|--------------------|--------------------|---------------------|--------------------|
| Machiavellianism | x | .260, $p = .024^*$ | .349, $p = .002^*$ | .384, $p = .001^*$ | .118, $p = .314$ |
| Narcissism | | x | .247, $p = .033^*$ | -.013, $p = .909$ | .259, $p = .025^*$ |
| Psychopathy | | | x | .101, $p = .386$ | .157, $p = .179$ |
| Lie Acceptability | | | | x | -.093, $p = .429$ |
| Self-Deception | | | | | x |
| d'_{Receiver} | -.026, $p = .828$ | -.145, $p = .216$ | -.059, $p = .617$ | -.022, $p = .854$ | -.196, $p = .092$ |
| C_{Receiver} | .094, $p = .422$ | .113, $p = .333$ | .082, $p = .484$ | .038, $p = .747$ | -.043, $p = .713$ |
| d'_{Sender} | -.103, $p = .379$ | .054, $p = .646$ | -.063, $p = .593$ | -.245, $p = .034^*$ | .131, $p = .261$ |
| C_{Sender} | -.098, $p = .404$ | .179, $p = .123$ | .045, $p = .702$ | -.093, $p = .426$ | .256, $p = .027^*$ |

(* indicates significant at $p < 0.05$).

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DecelT measures

Broad individual differences were observed in all four of the performance measures ($M d'_{\text{Receiver}} = 0.078$, $SD = 0.496$; $M C_{\text{Receiver}} = 0.065$, $SD = 0.193$; $M d'_{\text{Sender}} = 0.091$, $SD = 0.502$; $M C_{\text{Sender}} = -0.086$, $SD = 0.191$). As previously observed [5] detectability in the Sender role (d'_{Sender}) and the ability to discriminate in the Receiver role (d'_{Receiver}) were significantly correlated ($r = -0.471$, $p < .001$, Fig 1). As the ability to discriminate truthful from deceptive messages increased, the ability to produce deceptive messages that were less likely to be judged as deceptive in comparison to truthful messages, increased. This replicates the main finding presented in [5].

Participants reported greater Guilt, Anxiety and Cognitive Load when lying than when telling truth (Guilt $t_{(74)} = 8.029$, $p < .001$, Anxiety $t_{(74)} = 7.257$, $p < .001$, Cognitive Load $t_{(74)} = 7.588$, $p < .001$), and exhibited typical chronometric cues to deception (e.g. [46,47,5]). Response

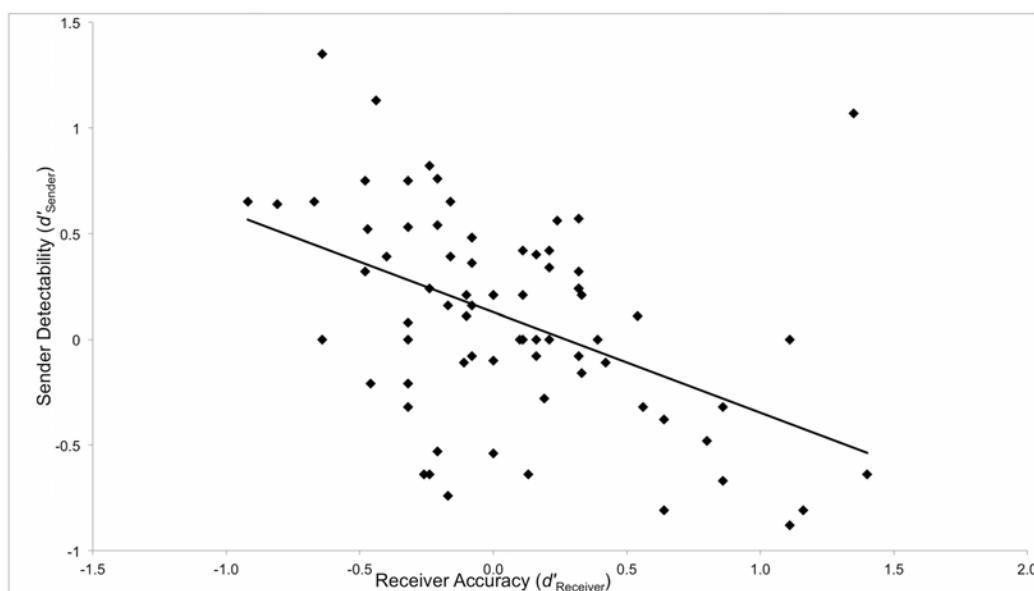


Fig 1. Correlation between Sender and Receiver performance using SDT measures for Receiver Accuracy (d'_{Receiver}) and Sender Detectability (d'_{Sender}): $r = -0.471$, $p < .001$.

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latency was significantly shorter when participants told the truth ($M = 4.128$ s $SD = 1.336$) than when they lied ($M = 5.510$ s $SD = 2.371$, $t_{(74)} = -6.409$, $p < .001$), while response duration was significantly longer for truthful statements ($M = 21.778$ s, $SD = 6.178$) than for deceptive statements ($M = 16.736$ s, $SD = 3.150$, $t_{(74)} = 6.818$, $p < .001$). Decreasing detectability in the Sender role (d'_{Sender}) was associated with a reduced response latency difference between truthful and deceptive statements ($r = 0.237$, $p = .040$), as observed in Wright et al. [5].

To permit comparison with previous studies, performance was also analysed using percentage accuracy. Overall accuracy in the Receiver role was found to be 51.49% ($SD = 9.39$), not significantly different from chance ($t_{(74)} = 1.373$, $p = .174$). To compare truth-bias in the Receiver role with previously reported findings we calculated the number of statements of all types classified by Receivers as truthful and found it to be 52.47% ($SD = 7.35\%$) a figure significantly higher than chance ($t_{(74)} = 2.912$, $p = .005$).

Associations between individual differences and DecelT performance measures

No association was observed between any of the Dark Triad measures (Machiavellianism, Narcissism or Psychopathy; see Table 1), or a combined Dark Triad score ($r = .133$, $p = .254$), and performance in either the Sender or Receiver roles in the DecelT task. However, a significant correlation was observed between Lie Acceptability Scale scores and discriminability in the Sender role (d'_{Sender} , $r = -.245$, $p = .034$); those who consider deception more acceptable tended to make deceptive statements that were *more* difficult to discriminate from the truth by Receivers, while a significant correlation was found between Self-Deception and credibility in the Sender role (C_{Sender} , $r = .256$, $p = .027$) indicating that individuals higher in the trait of self-deception appeared generally *less* credible in the task, i.e. overall their lies and truths were less likely to be believed. Step-wise multiple regressions using Dark Triad scores as predictor variables, and Sender and Receiver performance in the DecelT task as dependant variables were conducted, but failed to reveal any higher-order relationships between Dark Triad scores and deceptive ability.

Participants' self-reported confidence ratings were significantly lower for the deceptive condition ($M = 0.468$, $SD = 0.180$) than for the truthful condition ($M = 0.603$, $SD = 0.207$, $t_{(74)} = -4.762$, $p < .001$). The difference between confidence ratings for deceptive and truthful conditions (where lower scores indicate lower relative confidence in the lie condition) was found to correlate negatively with C_{Sender} ($r = -.253$, $p = .029$) and positively with self-deception ($r = -.312$, $p = .006$). Given that C_{Sender} (overall credibility) is derived such that lower scores indicate *higher* credibility, the negative relationship with confidence indicates that participants with higher overall credibility in the DecelT task were more confident. The positive relationship between self-deception and relative confidence when lying indicates that increasing self-deception is associated with less confidence when lying in comparison to when telling the truth. This relationship was driven by confidence when lying: individuals high in self-deception (by median split) were significantly less confident in the deceptive condition ($M = 0.416$, $SD = 0.174$) than those low in self-deception ($M = 0.520$, $SD = 0.173$, $t_{(73)} = -2.595$, $p = .011$), whereas no significant difference was observed for their confidence when telling the truth.

Discussion

The main finding of this study is that Dark Triad traits (Machiavellianism, Psychopathy or Narcissism) were not associated with the ability to either produce lies which others found difficult to discriminate from truth, or to discriminate truth from lies when judging others. However, Lie Acceptability was associated with the ability to produce successful lies. In addition, the

extent to which one engages in self-deception was found to correlate with poorer overall performance in the Sender role of the DeceIT task as measured by credibility (C_{Sender}).

From the characterisation of the 'Dark Triad' personality traits we expected to find that individuals scoring highly on such personality traits would show a greater deceptive ability. In contrast however, none of the individual Dark Triad measures were associated with either the ability to produce or to detect deception. These results are consistent with the extant research on Dark Triad traits and deceptive ability which have predominantly used non-interactive paradigms: although some previous research has claimed a link between Machiavellianism and deceptive ability (e.g. [19,6]), a meta-analysis of existing research found no support for an increased ability to lie in high Machiavellian individuals [22]; similarly the little empirical research conducted on the ability of psychopathic individuals to deceive has identified no particular deception-related ability [25,30]. As far as we are aware no previous study has looked at the deceptive ability of individuals with narcissistic traits.

A potential explanation for the inconsistent findings with regard to an association between Machiavellianism and the ability to produce successful lies may be found in the significant correlation between the degree to which participants rated lying as acceptable and their ability to produce successful lies. Machiavellianism and Lie Acceptability were significantly correlated (an acceptance of deception as a means of achieving one's goals is one of the primary features of the Machiavellian trait). This correlation was only of moderate strength however ($r = .384$) and so sampling bias in terms of Lie Acceptability within a high Machiavellian sample may determine the extent to which the high Machiavellian sample outperform a low Machiavellian sample via the mediating influence of Lie Acceptability. More generally, the association between Lie Acceptability and success in producing lies merits further investigation. At least two mechanisms may explain why those for whom lying is more acceptable are better able to lie. First, the endorsement of lying as an interpersonal strategy may permit an individual to lie more, and thus garner greater opportunities to practice deceiving others. Second, those who consider lying more acceptable might experience less of the guilt and anxiety brought about by lying [48] and therefore exhibit fewer associated cues. The second hypothesis received little support from the current data however, where the relationships between lie acceptability measures and self-reported guilt and anxiety when lying were not significant (analysed using differential scores, lie minus truth, or lie alone, $\max r = 0.111$, $p = .342$).

An experiential account is also likely to explain the association between C_{Sender} and the confidence with which people lie (relative to their confidence when telling the truth). C_{Sender} indexes an individual's general credibility (or Demeanour Bias)—irrespective of whether they are telling the truth or lying. Individuals with higher credibility reported higher relative confidence when lying than those with lower credibility. Sender demeanour has been shown to have a strong influence on the outcome of deceptive encounters [49], and the relationship between credibility and confidence may be an indication that individuals have learned their level of credibility over many deceptive encounters.

Self-deception was not associated with an increased ability to lie effectively in these data: no relationship was observed between the ability to deceive as indexed by d'_{Sender} —and the relationship between self-deception and general credibility was significantly *negative*. Thus, individuals high in self-deception were seen as generally less credible than those low in self-deception. This finding is in contrast to the hypothesis that self-deception contributes to deceptive success (e.g. [36,50], and with a recent investigation in a classroom setting [51]; however note that in this study participants were not actually lying, others were deceived by the participant's erroneous, but not deceptive, self-perception). Self-deception was hypothesized to be of benefit when lying in two ways. First, the self-deceptive individual no longer emits consciously-mediated cues to deception (such as signs of nervousness, guilt, or cognitive load) as they are

not aware that they are lying. Second, those who are self-deceptive are able to project an image of themselves as being more confident than they may otherwise seem (due to the ability to deceive themselves about their strengths and weaknesses), and gain the resultant social advantages (including being viewed as credible) that self-deception brings. The current data does not provide any support to the first hypothesis; the ability to deceive as measured by d'_{Sender} was not associated with self-deception, and the negative relationship between C_{Sender} and self-deception goes against the second hypothesis, as individuals higher in self-deception were generally perceived as being less credible. Interestingly, this effect may be mediated by confidence. In contrast to the hypothesized relationship between self-deception and confidence when lying, those high in self-deception had lower relative confidence that their lies would be believed ($r = -.312, p = 0.006$).

Of note is the replication of the association between skill in producing successful lies and in detecting the lies of others. This result was first found using the DeceIT paradigm [5], but required replication as two previous studies [6,7] had found lie production and detection skill to be unrelated (although it should be noted that the correlation between lie production and detection approached significance in the latter study). A possible reason for the discrepancy between the results obtained using the DeceIT procedure and the earlier studies is that the DeceIT procedure involved social interaction whereas the earlier studies did not. It is therefore plausible that whatever skill contributes to the correlation between detection and production of deception in the DeceIT paradigm is of maximum efficacy when social interaction is possible.

In both studies using the DeceIT paradigm a significant correlation was observed between discriminability when lying and an individual's increase in response time when lying. These data therefore suggest that when detecting deception, Receivers (lie detectors) use response latency as a cue to deception, and that good liars can control the extent to which they exhibit this cue. The use of response latency as a cue to deceit by those judging deception is valid; response latencies for deceptive statements were significantly longer than those for true statements. Whether the use / control of response latency by Receivers / Senders is deliberate or implicit is an interesting avenue for future investigation.

As in any experimental study of deception one must question the validity of the deceptive behaviour elicited by the experimental context. It could be argued that in the DeceIT paradigm the experimenter sanctions lies, and therefore the guilt associated with deception is reduced. We have discussed this issue, and the wider issue of laboratory-based deception research previously [5], and interested readers are directed to this paper. We briefly note that previous work suggests that there is very little difference in the detectability of sanctioned and unsanctioned lies (see meta-analysis by Sporer & Schwandt, [52]), and that participants were attempting to deceive other participants in a competitive scenario, rather than attempting to deceive the experimenter who had sanctioned the lie. While stakes were not of the magnitude involved in real-life criminal investigations, the availability of significant financial prizes and the competitive element of the task were designed to increase the likelihood that participants were engaged in the task.

In summary, despite the way in which its component traits are conceptualised, the Dark Triad appears unrelated to deceptive ability, either in the role of lie detector or liar. Although the current experimental sample ($n = 75$) is modest in comparison with individual differences questionnaire based research samples, sufficient variability was observed in Dark Triad traits to suggest any meaningful relationship with deceptive performance might have emerged. Indeed, power analysis suggests even the strongest relationship between Dark Triad measures and deceptive ability would require a sample of 191 participants in order to reach significance and would suggest poorer deception detection associated with Dark Triad traits rather than any deceptive skill.

In contrast, lie acceptability, the extent to which one endorses deceit and manipulative behaviour, relates positively to deceptive success. Furthermore, contrary to the hypothesis that self-deception is evolutionarily selected to promote the effective deception of others, these results suggest that high self-deceivers are less credible overall, and less confident when lying, than those low in self-deception. This study replicated the key findings of Wright et al. [5]: the ability to lie well correlates with an ability better to detect deception in others; and the control of response latency difference when lying may be key to producing successful lies, and to detecting those lies in others.

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Author Contributions

Conceived and designed the experiments: GW CB CC GB. Performed the experiments: GW. Analyzed the data: GW CB CC GB. Wrote the paper: GW CB CC GB.

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HUMAN BEHAVIOR AND DECEPTION DETECTION

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Abstract: Human intelligence is the key to stopping terrorism, and therefore it is essential to know when the information obtained is false. This article briefly outlines the research on behavioral clues to deception, as well as research on people's abilities to spot deception once it has happened. We find that there is no clue or clue pattern that is specific to deception, although there are clues specific to emotion and cognition. In general, behavioral clues are only limited in their abilities to identify deception and that there are still behavioral measurement issues that may plague research on deception. Moreover, a closer examination of the laboratory research suggests that many research studies are not relevant to security contexts, thus the research literature may underestimate the usefulness of behavioral information—particularly for the utility of identifying emotional and cognitive states. We also find that most people, unaided by technology, cannot detect lies from behavioral information, but that some groups do show significantly higher levels of accuracy—although more research is needed to understand why. We conclude that a more directed interaction with scientists and practitioners—in both lab work and in the real world, in creating real-world databases, identifying base rates for malfeasant behavior in security settings, optimizing training, and identifying preexisting excellence within security organizations can more rapidly capitalize on the usefulness of behavioral information in security settings.

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Keywords: behavior; cognition; deception; detection; emotion; judgment; lying; malfeasance; memory

Terrorism at its core is a human endeavor. Human beings cultivate what they hate, plan, and then execute terrorist attacks. Thus, any information that can aid the intelligence or security officer to weigh the veracity of the information he or she obtains from suspected terrorists or those harboring them would help prevent attacks. This would then not only add another layer to force protection but would facilitate future intelligence gathering. Yet the face-to-face gathering of information through suspected terrorists, informants, or witnesses is replete with obstacles that affect its accuracy such as the well-documented shortcomings of human memory, honest differences of opinion, as well as what is the focus of this article—outright deception [1].

The evidence suggests that in day-to-day life most lies are betrayed by factors or circumstances surrounding the lie, and not by behavior [2]. However, there are times when demeanor is all a Homeland security agent has at his or her disposal to detect someone who is lying about his or her current actions or future intent. Because a lie involves a deliberate, conscious behavior, we can speculate that this effort may leave some trace, sign, or signal that may betray that lie. What interests the scientist, as well as society at large, is (i) are there clues perceptible to the unaided eye that can reliably discriminate between liars and truth tellers; (ii) do these clues consistently predict deception across time, types of lies, different situations, and cultures?; and if (i) and (ii) are true, then (iii) How well can our counter-terrorism professionals make these judgments, and can they do this in real time, with or without technological assistance?

1 SCIENTIFIC OVERVIEW—BEHAVIORAL SIGNS OF DECEPTION

To date no researcher has documented a “Pinocchio response”; that is, a behavior or pattern of behaviors that in all people, across all situations, is specific to deception (e.g. [3]). All the behaviors identified and examined by researchers to date can occur for reasons unrelated to deception. Generally speaking, the research on detecting lies from behavior suggests that two broad families of behavioral clues are likely to occur when someone is lying—clues related to liar’s memory and thinking about what they are saying (cognitive clues), and clues related to liar’s feelings and feelings about deception (emotional clues) [3–8].

1.1 Cognitive Clues

A lie conceals, fabricates, or distorts information; this involves additional mental effort. The liar must think harder than a truth teller to cover up, create events that have not happened, or to describe events in a way to allow multiple interpretations. Additional mental effort is not solely the domain of the outright liar; however, a person who must tell an uncomfortable truth to another will also engage in additional mental effort to come up with the proper phrasing while simultaneously reducing the potential negative emotional reaction of the other. This extra effort tends to manifest itself with longer speech latencies, increased speech disturbances, less plausible content, less verbal and vocal involvement, less talking time, more repeated words and phrases, and so forth [9]. Research has also shown that some nonverbal behaviors change as a result of this mental effort. For example, illustrators—hand or head movements that accompany speech, and

are considered by many to be a part of speech (e.g. [10])—will decrease when lying compared to telling the truth [11, 12].

Another way in which cognition is involved in telling a lie is through identification of naturalistic memory characteristics. This means that experienced events have memory qualities that are apparent upon description that are different from events that have not been experienced (the “Undeutsch hypothesis” [13]). Events that were not actually experienced feature more ambivalence, have fewer details, a poorer logical structure, less plausibility, more negative statements, and are less embedded in context. Liars are also less likely to admit lack of memory and have less spontaneous corrections (reviewed by [8, 9]), and may use more negative emotion words and fewer self and other references [14]. Mental effort clues seem to occur more in the delivery of the lie, whereas memory recall clues tend to rest more in the content of the lie.

We note that not all lies will tax mental effort; for example, it is much less mentally taxing to answer a close ended question like “Did you pack your own bags?” with a yes or no than to answer an open ended “What do you intend to do on your trip?” Moreover, a clever liar can appear more persuasive if he or she substitutes an actual experienced event as their alibi rather than creating an entirely new event. This may be why a recent general review paper [9] found consistent nonhomogeneous effect sizes for these mental effort and memory-based cues across the studies they reviewed, as the particular paradigms used by researchers varied greatly in the extent to which the lies that were studied mentally taxed the liars.

1.2 Emotional Clues

Lies can also generate emotions, ranging from the excitement and pleasure of “pulling the wool over someone’s eyes” to fear of getting caught to feelings of guilt [4]. Darwin [15] first suggested that emotions tend to manifest themselves in the facial expressions, as well as in the voice tones, and that these could be reliable enough to accurately identify emotional states. Research has since shown that for some expressions—e.g. anger, contempt, disgust, fear, happiness, sadness/distress, or surprise—cultures throughout the planet recognize and express these emotions in both the face and voice similarly [16]. To the extent that a lie features higher stakes for getting caught, we would expect to see more of these signs of emotion in liars compared to truth tellers. If the lie is a polite lie that people tell often and effortlessly, there would be less emotion involved (e.g. [17]). Meta-analytic studies suggest that liars do appear more nervous than truth tellers, with less facial pleasantness, higher vocal tension, higher vocal pitch, greater pupil dilation, and fidgeting [9]. If the lie itself is about emotions—e.g. telling someone that one feels calm, when in fact one is nervous—the research shows that signs of the truly felt emotion appear in the face and voice despite attempts to conceal, although these signs are often subtle and brief [18, 19].

1.3 Measurement Issues

One issue in measuring lie signs is to make clear what is meant by the terms cognition and emotion. For example, in deception research, the term arousal is used interchangeably with emotion, but often refers to many different phenomena: an orienting response [20], an expression of fear [21], a more indeterminate affect somewhere between arousal and emotion ([22]; see also discussion by Waid and Orne [23]), as well as physiological states as different as stress, anxiety, embarrassment, and even anger [24].

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A second issue in measuring lie signs is to clarify the level of detail of measurement as well as to specify why that level of detail may or may not correlate with lying [25]. Many meta-analyses of behavioral deception clues report insignificant effect sizes, but the variance among effect is not homogeneous (e.g. [3, 926–28]). For example, some studies investigated behavior at the most elemental *physical* units of measurement such as counting the movements in the hands, feet, arms, legs, torso, eye movements, eye blinks, pupil dilation, lip pressing, brow lowering or raising, lip corner puller (smiling), fundamental frequency, amplitude, pauses, filled pauses, response latency, speech rate, length of response, connector words, unique words, self-references, and so forth. Other studies investigated behavior at the most elemental *psychological meaning* units of measurement. Some of these included manipulators—which involve touching, rubbing, etc., of various body parts—which could be composed of a number of hand, finger, and arm movements, but which were scored for theoretical rather than merely descriptive reasons. Other psychologically meaningful units of measurement include illustrators, which accompany speech to help keep the rhythm of the speech, emphasize a word, show direction of thought, etc. or emblems, which are gestures that have a speech equivalent, such as a head nod meaning “yes”, or a shrug meaning “I am not sure”, or facial emblems such as winking. The psychological meaning units might also include vocal tension, speech disturbances, negative statements, contextual embedding, unusual details, logical structure, unexpected complications, superfluous details, self-doubt, and so forth. Finally, other studies investigated behavior at the most *interpretative/impressionistic* unit level, which are further unarticulated composites of the physical and the psychological meaning units described earlier. Some of these impressionistic variables of the behaviors include fidgeting, involvement, body animation, posture, facial pleasantness, expressiveness, vocal immediacy and involvement; and spoken uncertainty; plausibility; and cognitive complexity (see review by [9]). The problem of course is that as one moves from physical to impressionistic measures, it would seem to become harder to make those judgments reliably. This is not always the case though, for example, the term “smile” has rarely been defined in research reports, yet independent coders are typically above 0.90 reliability when coding smiles (see [29] for a review). Although research works suggest that people can be more accurate when they employ indirect inferences to deception (e.g. does the person have to think hard? [30]), “gut” impressions tend to be uncorrelated with accuracy [26]. This suggests that we must be cautious about clues at the impressionistic level, and that it may be more productive to study them at their psychological level where they might be more meaningful to understanding deception.

1.4 Prognosis on Generalizability of Deception Findings Across Time, Lies, Situations, and Cultures

It is safe to conclude that although there are some clues that betray a lie at rates greater than chance, none of them are exclusive to deception. This conclusion applies to machine based physiological approaches as well. However, the origins of these signs—mental effort, memory, and emotion—are universal. This suggests that if the context in which the information is gathered is controlled, and designed to differentially affect liars and truth tellers, it would increase greatly the chances of being able to distinguish people with deceptive intent from those with truthful intent. Polygraph examination has done this by controlling their question style to improve hit rates, but to date this has not been done systematically in behavioral studies. Thus its effects are unknown, but we can speculate

SCIENTIFIC OVERVIEW—ABILITIES TO SPOT LIARS 5

based upon what we know about normal, truthful human behavior. If the lie is of no significance to the person, with no costs for getting caught, and involves a simple yes or no answer, odds are there will not be many clues to distinguish the liar from the truth teller. If the situation has significance to the person, there are consequences for getting caught, and the person is required to recount an event in an open ended question, then we would expect more clues to surface that would distinguish the liar from the truth teller. This may be a curvilinear relationship; a situation of extraordinary high mental effort and emotion—e.g. one in which a person is being beaten, screamed at, and threatened with execution—will generate all the “lie clues” described earlier, but equally in liar and truth teller. Nonetheless, information about mental effort, experienced memory, and emotion can be very useful clues to Homeland Security personnel to identify behavioral “hot spots” [4] that can provide information about issues of importance to the subject. A counter-terrorism Intelligence officer who knows when a subject is feeling an emotion or thinking hard can know what topics to pursue or avoid in an interview, whether the subject is fabricating, concealing information, or merely feeling uncomfortable with the topic, although truthful.

2 SCIENTIFIC OVERVIEW—ABILITIES TO SPOT LIARS

Research over the past 30 years suggests that the average person is slightly statistically better than chance at identifying deception, but not practically better. The most recent review of over 100 studies has shown that when chance accuracy is 50%, the average person is approximately 54% accurate [31]. There are a number of reasons for this poor ability; among them poor feedback in daily life (i.e. a person only knows about the lies they have caught); the general tendency among people to believe others until proven otherwise (i.e. a “truth bias”; [32]), and especially a faulty understanding of what liars actually look like (i.e. the difference between people’s perceived clues to lying, compared to the actual clues; [26]).

2.1 General Abilities of Specialized Groups

Most of the studies reviewed were laboratory based and involved observers judging strangers. But similar results are found even when the liars and truth tellers are known to the observers (also reviewed by [31]. If the lies being told are low stakes, so that little emotion is aroused and the lie can be told without much extra cognitive effort, there may be few clues available on which to base a judgment. But even studies of high stakes lies, in which both liars and truth tellers are highly motivated to be successful, suggest an accuracy level that is not much different from chance.

Researches that examined unselected professionals involved in security settings—police, federal agents, and so forth—have typically found that they too are not any more accurate in their abilities to spot deception than laypeople (e.g., [27,33–36]). However, within these studies there have been a handful of groups that have performed better than 60% accurate on both lies and truths, and what these groups are doing might be informative for Homeland Security applications. The first group identified was a group of Secret Service agents who not only were superior, as a group, in detecting lies about one’s emotions, but those who were more accurate were more likely to report using nonverbal clues than those who were less accurate. The authors [33] speculated that the Secret Service agents were more accurate than the other groups

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because they were trained in scanning crowds for nonverbal behaviors that did not fit, and they also dealt with assassination threats, many of which were made by mentally ill individuals. Unlike most police officers whose assumption of guilt in suspects is high [37], reflecting the experience of their daily work, Secret Service agents interviewed suspects where they knew the base rate of true death threats was low. The second set of groups identified included forensic psychologists, federal judges, selected federal law enforcement officers, and a group of sheriffs [34]. A commonality among these groups seemed to be their very high motivation to improve their lie detecting skills. A third set of groups identified were police officers examining real-life lies, who showed 65% overall accuracy in detecting lies and truths [38].

2.2 Individual Differences

As with any ability, research suggests that some people are better able to detect deception than others in high-stake lies (e.g. [39]); this skill does not seem to translate to lower-stake lies [32]. One element of better skill in higher-stake settings is the ability to judge micromomentary displays of emotion [33, 39]. Other groups who showed better than 60% accuracy included people with left hemisphere brain lesions that prevented them from comprehending speech [40], and those subjects who scored higher on a test of knowledge of clues to deceit were also more accurate than those who did not [41]. A different approach has been to identify individuals who obtain high scores on lie detection tests and studying them in detail [42]. After testing more than 12,000 people using a sequential testing protocol involving three different lie detection accuracy measures, O'Sullivan and Ekman identified 29 highly accurate individuals. These individuals had a kind of genius with respect to the observation of verbal and nonverbal clues, but since genius often connotes academic intelligence, the expert lie detectors were labeled "truth wizards" to suggest their special talent. Although this term is unfortunate in mistakenly suggesting that their abilities are due to magic rather than talent and practice, the term does reflect the rarity of their abilities. One of the first findings of the Wizard Project was a profession-specific sensitivity to certain kinds of lies. About one-third of the wizards were highly accurate on all three of the tests used. Another third did very well on two of the tests, but not on the third, in which people lied or told the truth about whether they had stolen money. Nearly all of these wizards were therapists who had little, if any, experience with lies about crime. On the other hand, the remaining third of the wizards were law enforcement personnel—police and lawyers—who did very well on the crime lie detection test, but not on a test in which people lied or told the truth about their feelings. Compared with a matched control group, expert lie detectors are more likely than controls to attend to a wide array of nonverbal behaviors and to be more consciously aware of inconsistencies between verbal and nonverbal behaviors. Although expert lie detectors make almost instantaneous judgments about the kind of person they are observing, they are also more cautious than controls about reaching a final decision about truthfulness.

3 CRITICAL NEEDS ANALYSIS

Research on human behavior and deception detection can make a useful contribution to Homeland Security needs as long as scientists and practitioners understand what it

is they are observing—signs of thinking or signs of feeling. This rule applies to automated approaches that measure physiology as well. Even with this limitation, training in behavioral hot spot recognition may make security personnel better at spotting those with malfeasant intent. Other critical needs are discussed below.

3.1 More Relevant Laboratory Paradigms and Subjects

Q2 We must recognize that general meta-analyses of the research literature, although useful, are limited in their applicability to security contexts, since such analyses tend to combine studies that feature lies told with few stakes and cognitive demands with those with higher stakes and stronger cognitive demands. Thus, we should be more selective about which studies to examine for clues that may be useful or relevant to security contexts. This also means it is important for scientists to develop research paradigms that more closely mirror the real-life contexts in which security personnel work. Although laboratory settings are not as powerful as real-world settings, high-stake laboratory deception situations can provide insights with the best chance of applicability. Consistent with this approach, two current airport security techniques capitalize on behaviors identified by research studies on stress, with anecdotal success (i.e. TSA's Screening Passengers by Observation Techniques and the MA State Police Behavioral Assessment System). One way to facilitate this type of progress is to have Homeland Security personnel advise laboratory research, as well as allow researchers to spend on-the-job time with them. We believe that pairing the researchers and practitioners would eventually result in calls for laboratory studies featuring higher stakes to the liars, different subject populations beyond US/Europeans (as research suggests that people can detect deception in other cultures at rates greater than chance; [43, 44]), and differing interview lengths such as examining shorter interviews (i.e. a 30–90 s security screening) and longer interviews (i.e. a 1–4 h intelligence interview).

3.2 Examination and Creation of Real-World Databases

There have been very few studies of real-world deception (e.g. [38]), yet the technological capability exists to create many more. The biggest problem with real-world data is determining the ground truth (was the person really lying, or did he or she truly believe what he or she just stated?). Estimating ground truth—as compared to knowing ground truth—will slow down the identification of any patterns or systems. Clear criteria must be established *a priori* to determine this ground truth. For example, confessions of malfeasance are a good criterion, but false confessions do happen. Catching someone with contraband (i.e. a “hit”) is also a good criterion, but occasionally the person may be truthful when he or she states that someone must have snuck it into his or her luggage. Moreover, academics should advise on the capture and recording of these databases, to ensure that the materials are able to be examined by the widest number of researchers and research approaches. For example, most of the police interview video we have seen is of such poor quality that we cannot analyze facial expressions in any detail. It is only when these databases are combined with the laboratory work that we can more sharply identify behaviors or behavioral patterns that will increase the chances of catching those with malfeasant intent. To optimally use this information though, we must also examine in detail known cases of false negatives and false positives as well as correct hits to determine why mistakes were made in these judgments.

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3.3 Ground Truth Base Rates

Security personnel do not know the base rates for malfeasance in their settings. Although it may be logistically impossible to hand-search every piece of hand luggage in a busy airport, or follow every investigative lead, it would be essential to know this base rate in order to ascertain the effectiveness of any new behavioral observational technique. This would also permit more useful cost–benefit analyses of various levels of security and training. A less satisfying but still useful way to ascertain effectiveness is to compare hit rates for contraband for those using various behavioral observation techniques with those who are stopped randomly (as long as the day of the week and time of the day/year are scientifically controlled).

3.4 Optimizing Training

The most recent meta-analysis of the research literature on training people to improve deception detection from behavior has shown that across over 2000 subjects, there was a modest effect for training, despite the use of substandard training techniques [45]. This obviously suggests that better training techniques will yield larger improvements in people’s abilities to sort out truth from lie. One training change would be to train on behavioral clues that are derived from similar situations and supported by research. For example, one study trained research subjects to recognize a set of behavioral clues that are believed to be indicative of deception, and are often taught to law enforcement personnel as signs of deception, although many of these signs are not supported by the scientific literature [46]. This study reported a 10% decrease in accuracy for the groups receiving such training. Therefore, the first step in adequate training is to identify what information is useful for training (see above). The second step is to determine the most effective way to deliver that information. For example, what is the training duration that maximizes comprehension—one full day, three full days, or more? Should it be done in a group or self-study? Does it need simple repetition, or more creative approaches, and how many training items are needed? Does it need to be reinforced at particular intervals? How many clues should be taught—i.e. at what point do you overwhelm trainees? How do you train in such a way as to improve accuracy without overinflating confidence? These are just a few of the questions with unknown answers.

3.5 Identifying Excellence

Another critical need is to identify who within relevant organizations shows signs of excellence, through their higher hit rates or whatever other clear criteria can be applied. This strategy is similar to the strategy of the “wizards” study [42]. One caution is that to date, most testing material will be laboratory experiment based, and the generalizability of that information to real-world contexts is not perfect. An examination of the convergent validity of laboratory tests of deception detection and other more naturalistic approach measures (peer ratings, field observations in airports, or other points of entry with accuracy determined by the rate of contraband “hits” by individuals compared to random selection) would be a great start.

4 FUTURE RESEARCH DIRECTIONS

The aforementioned critical needs suggest several research questions, but by no means is that section comprehensive. As we peer into the future, there is much work to do. A partial list of future directions shown below suggests what we should do.

- Examine the role of technology in facilitating behavioral observation. A number of computer vision algorithms are now available that can aid observation, such as recognizing emotional expressions in the face (e.g. [47]). What is unknown is how robust these algorithms are in real-world contexts. What is also unknown is how best to combine technological observation of behavior with human judgment. Would there be a tendency for humans to overrely upon the technology over time?
- Identify the optimal environmental set up for surveillance, whether with technology or the unaided eye. This includes proxemic placement of tables, lines, stanchions, other individuals, and so forth. One goal would be to create an environment that would reduce the typical stress felt by the normal traveler, which would hopefully increase the salience of any sign of stress exhibited by the malfeasant to increase the chances of its being observed.
- Identify optimal interaction style between security agents and the public. One can aggressively question and threaten travelers, but that might render behavioral observation useless due to the overall stress engendered. A rapport-building approach (e.g. [48]) might be better, but this needs more research.
- Identify the optimal interview style. Phrasing of questions is important in obtaining information, but this has not been researched in the open literature. Small changes in phrasing—e.g. open versus close ended—might add to the additional cognitive burden of the liar and thus could be useful. The order of questions will also be important, as well as whether one should make a direct accusation. But only additional research will tell.
- Identify the optimal way to combine behavioral clues. Research tends to examine individual behavioral clues to ascertain their effectiveness, yet more modern neural network and machine learning approaches may be successful in identifying patterns and combinations of behaviors that better predict deception in particular contexts.
- Identify the presence of countermeasures. An inevitable side effect of the release of any information about what behaviors are being examined by security officers, to identify riskier individuals in security settings, is that this information will find its way onto the Internet or other public forums. This means a potential terrorist can learn what to do and what not to do in order to escape further scrutiny. The problem is that we do not know yet whether one can conceal all their behaviors in these real-life contexts. Moreover, some of these behaviors, like emotional behavior, is more involuntary [16] and should be harder to conceal than more voluntary behavior like word choice. Thus it remains an open question as to whether a potential terrorist can countermeasure all of the critical behaviors.

Space limitations preclude an exhaustive list of needs, future directions, and research. In general, the research suggests that there are limited clues that are useful to sorting out liars and truth tellers, but most people cannot spot them. However, a closer examination of this literature suggests that some behavioral clues can be useful to security personnel, and some people can spot these clues well. We feel that it may be ultimately most

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productive to expand our thinking about behavioral clues to deceit to include thinking about behavioral clues to a person's reality—clues that someone is recounting a true memory, thinking hard, or having an emotion he or she wishes to hide. This would enable a security officer to make the most accurate inference about the inner state of the person they are observing, which, when combined with better interaction and interviewing techniques, would enable them to better infer the real reasons for this inner state, be it intending us harm, telling a lie, or telling the truth.

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CROSS-REFERENCES

Social and psychological aspects

Terrorism risk: characteristics and features

DeterrencePhysical security; models and countermeasures

Queries in Chapter 299

- Q1. "Mental effort clues seem to occur more in the delivery of the lie, whereas memory recall clues tend to occur in the content of the lie." has been changed to "Mental effort clues seem to occur more in the delivery of the lie, whereas memory recall clues tend to rest more in the content of the lie.". Please confirm if it retains the intended meaning.
- Q2. Please confirm if this abbreviation "TSA" needs to be spelt out. If yes, please provide the expansion.
- Q3. Please provide the publisher's name and place of publication for reference `<xref target="hhs299-bib-0026" style="unformatted"/>`.
- Q4. Please provide the article ID for this article title "Deterrence".Physical security; Please provide the article ID for the title "Physical security; models and counter-measures" .

Let Me Inform You How to Tell a Convincing Story:
CBCA and Reality Monitoring Scores as a Function of Age, Coaching and Deception

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Coaching and Deception

Abstract

The first aim of this experiment was to examine whether being informed about a method of detecting deception called Criteria-Based Content Analysis (CBCA) would increase participants' CBCA scores when deceptive so that they might then be classified as truthful. The second aim was to investigate whether Reality Monitoring could be used as an alternative tool for verbal lie detection. The third aim was to examine whether participants' social skills (social anxiety, self monitoring and social adroitness) affected their CBCA scores. Participants (aged 6-8, 11-12, 14-15, and undergraduates) participated in a "rubbing the blackboard" event. In a subsequent interview they told the truth or lied about the event, after they were or were not taught some CBCA criteria. Truth tellers obtained higher CBCA scores than liars, and those who were informed about CBCA obtained higher scores than those who were not, except for the 6-8-year-olds. CBCA scores were also significantly correlated with social skills. Finally, Reality Monitoring was a useful alternative to CBCA for distinguishing between liars and truth tellers.

Let Me Inform You How to Tell a Convincing Story:

CBCA and Reality Monitoring Scores as a Function of Age, Coaching and Deception

To date, Criteria-Based Content Analysis (CBCA) -a systematic assessment of the credibility of written statements- is probably the most popular instrument to assess the veracity of written statements (Vrij, 2000).

CBCA is a systematic assessment of the credibility of written statements. Steller and Köhnken (1989) compiled a list of 19 criteria which had been used in such assessments. CBCA is based on the hypothesis, originally stated by Undeutsch (1967), that a statement derived from memory of an actual experience differs in content and quality from a statement based on invention or fantasy. This is known as the Undeutsch Hypothesis (Steller, 1989). The presence of each criterion strengthens the hypothesis that the account is based on genuine personal experience. Köhnken (1989, 1996, 1999, 2002) presented theoretical support for the Undeutsch hypothesis and proposed that both cognitive and motivational factors influence CBCA scores.

With regard to cognitive factors, it is assumed that, compared to those who fabricate a story, someone who actually experienced an event would be able to produce descriptions about this event which include more CBCA criteria, as some criteria (unstructured production, contextual embedding, reproduction of speech, unusual details, etc.) are believed to be very difficult for people to fabricate.

Other criteria are more likely to occur in truthful statements for motivational reasons. Truthful persons will not be as much concerned with impression management as will deceivers. Compared to truth tellers, deceivers would be more keen to try to construct a report which they believe will make a credible impression on others, and will leave out information which, in their view, will damage their image of being a truthful person (Köhnken, 1999). As a result, a truthful person's statement is more likely to contain information that is inconsistent with the beliefs/stereotypes that people have concerning truth

telling. The CBCA list includes several so-called "contrary-to stereotype" criteria (term adapted from Ruby & Brigham (1998)): "spontaneous corrections", "admitting lack of memory", "raising doubts about one's own testimony", etc..

CBCA was developed to evaluate statements from children. Many authors still describe CBCA as a technique solely developed to evaluate statements made by children in sexual offense trials (Honts, 1994; Horowitz, Lamb, Esplin, Boychuk, Krispin, & Reiter-Lavery, 1997). Others, however, advocate the additional use of the technique to evaluate the testimonies of adults (Köhnken, Schimossek, Aschermann, & Höfer, 1995; Porter & Yuille, 1996; Ruby & Brigham, 1997; Steller & Köhnken, 1989). These authors have pointed out that the underlying Undeutsch hypothesis is not restricted to children. The latter point of view has received some empirical support to date. Significantly higher CBCA scores for truth tellers than for liars have not only been found in studies with children witnesses (for example, Akehurst, Köhnken, & Höfer, 2001; Lamb, Sternberg, Esplin, Hershkowitz, Orbach, & Hovav, 1997a, b; Lamers-Winkelmann & Buffing, 1996; Tye, Amato, Honts, Kevitt, & Peters, 1999; Vrij, Akehurst, Soukara, & Bull, 2002; Winkel & Vrij, 1995) but also in studies with adult witnesses (for example, Akehurst et al., 2001; Höfer, Akehurst, & Metzger, 1996; Köhnken et al., 1995; Landry & Brigham, 1992; Porter & Yuille, 1996; Ruby & Brigham, 1998; Sporer, 1997; Vrij, Edward, & Bull, 2001a, b; Vrij et al., 2002; Zaparniuk, Yuille, & Taylor, 1995).

In the present study it was predicted that CBCA scores would be significantly higher for truth tellers than for liars in both adult statements and child statements (Hypothesis 1). It was further predicted that there would be a linear relationship between age and CBCA scores: the older the participants, the higher their CBCA score (Hypothesis 2). Theoretically, Hypothesis 2 could be explained in several ways. Cognitive abilities and command of language develop throughout childhood, making it gradually easier to provide detailed and rich accounts of what has been witnessed (Davies, 1991, 1994). Also, children are probably

less aware and/or less concerned with impression management than adults (Flavell, Botkin, Fry, Wright, & Jarvis, 1968; Vrij, 2002). Positive correlations between CBCA scores and age have been found in numerous studies before (see Vrij, in press, for an overview of these studies).

In principle, it is possible that if people were to learn which methods CBCA evaluators use to assess the credibility of their statements, they could try to "improve" their statements in order to obtain high CBCA scores which could then be assessed as truthful by CBCA judges. Previous experiments addressing this "coaching" issue have revealed that lying participants who were informed about CBCA were indeed capable of producing significantly higher CBCA scores than lying participants who were not informed (Vrij et al., 2002; Vrij, Kneller, & Mann, 2000). The present experiment also addressed the question of whether it is possible for people who have insight into the CBCA method to improve their CBCA score. The main difference between the previous experiments and this experiment was the age of the participants. Unlike the other experiments, we included a group of young participants (6-8-year-olds). We expected participants to benefit from the coaching and predicted that CBCA-coached participants would obtain higher CBCA scores than uncoached participants (Hypothesis 3).

Recently, Reality Monitoring has been used as an alternative method to examine verbal differences between responses believed to be true and false (Alonso-Quecuty, 1992, 1996; Alonso-Quecuty, Hernandez-Fernaudo, & Campos, 1997; Höfer et al., 1996; Manzanero & Diges, 1996; Roberts, Lamb, Zale, & Randall, 1998; Sporer, 1997; Vrij, Akehurst, Soukara, & Bull, in press; Vrij, Edwards, Roberts, & Bull, 2000; Vrij et al., 2001a, b). The core of Reality Monitoring is the claim that memories of experienced events differ in quality from memories of imagined (e.g., fabricated) events. Memories of real experiences are obtained through perceptual processes and are therefore likely to contain, amongst others, perceptual information: details of smell, taste or touch, visual details and auditory details

(details of sound) and contextual information: spatial details (details about where the event took place, and details about how objects and people were situated in relation to each other, e.g., "He stood behind me") and temporal details (details about time order of the events, e.g., "First he switched on the video-recorder and then the TV", and details about duration of events). Accounts of imagined events are derived from an internal source and are therefore likely to contain cognitive operations, such as thoughts and reasonings ("I must have had my coat on, as it was very cold that night") (Johnson, Hashtroudi, & Lindsay, 1993; Johnson & Raye, 1981, 1998). One might argue that "experienced events" reflect truth telling whereas "imagined events" reflect deception. Therefore, differences between truth tellers and liars could be expected regarding Reality Monitoring criteria.

One of the benefits of the Reality Monitoring method, compared to CBCA, is that the method is relatively straightforward to use and less time consuming to apply (Sporer, 1997; Vrij et al., 2000, in press). Another benefit is that, unlike CBCA which consists of criteria solely related to truth telling, Reality Monitoring contains both truth telling criteria and a criterion indicative of deception (cognitive operations). However, Reality Monitoring needs to be more thoroughly tested. For example, previous studies often have failed to find the expected difference between liars and truth tellers regarding cognitive operations (Alonso-Quecuty, 1992, 1996; Höfer et al., 1996; Sporer, 1997; Vrij et al., 2000, 2001b). This might have been caused by the nature of the event. For example, in Vrij et al.'s (2000, 2001b) studies, participants were requested to give truthful or deceptive factual accounts of aspects of a film they had seen. This allows little room for cognitive operations. Truth tellers were asked to recall and liars were asked to fabricate what people in the film were doing, not what they, themselves, were thinking. Cognitive operations, however, are related to people's own thinking rather than recall of factual information about others. Therefore, the expected difference in cognitive operations between liars and truth tellers might occur when people are asked to describe their own activities during a certain period of time as this provides more

opportunity to include reports of cognitive operations. In support of this reasoning, Vrij et al. (in press) found that liars did include more cognitive operations in their accounts than truth tellers when they were asked to describe an event in which they were personally involved. In order to further strengthen the support for the cognitive operations hypothesis we sought to replicate this finding in the present study. It was hypothesised that truth tellers are likely to include more perceptual and contextual information in their statements than liars, and that liars are likely to include more cognitive operations in their statements than truth tellers (Hypothesis 4). For the same reason that we expected age differences in CBCA scores (i.e., cognitive abilities and command of language develop throughout childhood which makes it gradually easier to provide detailed accounts), we expected age differences in Reality Monitoring scores as well: The older the participants, the higher their Reality Monitoring score (Hypothesis 5).

Vrij et al. (2002) examined individual differences in CBCA scores. They argued that some people are more eloquent and verbally skilled than others, and that these differences may be related to social skills. They focused on three different social skills: social anxiety, social adroitness and self monitoring. People who are socially anxious feel discomfort in the presence of others (Buss, 1980) and their reports might therefore contain less quality (contain fewer CBCA criteria) than participants who feel more comfortable in social interactions. On the other hand, people who are socially adroit (Jackson, 1978) are experienced in verbally manipulating other people. As a result, their statements might contain more CBCA criteria than the statements of those who are less manipulative. Finally, people differ in the extent to which they naturally engage in impression management. Those who are high in self-monitoring (Snyder, 1987) are particularly concerned with making a favourable impression on others, and have the tendency to adjust their nonverbal and verbal behavior in order to create the desired effect on others. Therefore, it might be that high self monitors naturally produce higher CBCA scores. Vrij et al.'s (2002) findings supported these

assumptions. Their findings have potential implications. Statement Validity Assessment (SVA) experts typically look at alternative hypotheses to explain CBCA scores, such as cognitive limitations of the child, characteristics of the interview, and motivational factors. All these aspects are addressed in the Validity Checklist (Raskin & Esplin, 1991). Social skills of the interviewee, however, do not appear in the Validity Checklist and are therefore typically neglected. Vrij et al.'s (2002) findings suggest that social skills need to be incorporated in the Validity Checklist. However, the correlations found between CBCA scores and social skills were, although significant, not high (around $r = .20$). We therefore felt that a replication of these findings was desirable. Obviously, if the same findings were obtained, the plea to include social skills of the interviewee in the Validity Checklist would be strengthened. The relationship between social skills and Reality Monitoring scores have not been investigated to date. However, similar to CBCA scores, Reality Monitoring scores are probably related to eloquency, and we therefore expected the same relationships as for CBCA scores. In all, we predicted that social anxiety would be negatively correlated with CBCA scores and Reality Monitoring scores and that social adroitness and self monitoring would be positively correlated with CBCA and Reality Monitoring scores (Hypothesis 6).

Method

Participants

A total of 180 participants took part in the study, 92 (51%) males and 88 (49%) females. Their mean age was $M=14.13$ years, $SD=5.56$. There were four different age groups: 44 6 to 8-year-olds (13 (30%) males and 31 (70%) females, four were 6 years old, 30 were 7 years old, and 10 were 8 years old), 35 11 to 12-year-olds (21 (60%) males and 14 (40%) females, 16 were 11 years old and 19 were 12 years old), 44 14 to 15-year-olds (23 (52%) males and 21 (48%) females, 13 14-year-olds and 31 15-year-olds), and 57 undergraduate students (35 (61%) males and 22 (39%) females, their mean age was $M=20.70$ years, $SD = 3.40$).

Procedure

The experimental procedure was identical to Vrij et al.'s (2002, in press) procedures. The experiment took place at a Students' Union (for undergraduates) and at local schools (for children). Undergraduates were recruited under the guise of participating in an experiment about "telling a convincing story" with the possibility of earning £5. Children were asked by their teacher to go to see "a woman to play a game". (Prior to the study, parental informed consent was obtained). Participants took part individually. First, the undergraduates signed an informed consent form and filled out a questionnaire "about their personality" (which included self reports concerning social anxiety, social adroitness and self monitoring, see below). The 11-, 12-, 14- and 15-year-olds also filled out this questionnaire prior to the study. For the 6-8-year-olds, the questionnaire was sent to their parents (after the children had participated) who were asked to fill out the questionnaire on behalf of their children. After entering the experimental room, the female experimenter made fairly brief, polite conversation (exchanged names, what have you been doing?, etc.). From that moment events differed for the participants depending on which of the conditions they were in. Allocation to these conditions occurred at random.

Participants in the truthful condition ($N = 86$) played a game of "Connect 4" with the experimenter (all 180 participants in this study knew how to play this popular game). During the game, a person (we used different persons, see below) entered the room, said "Hello", and "Excuse me for interrupting", and also said "Ah! You are playing Connect 4, I'm hopeless at the game, I always lose!", walked to the blackboard and wiped some information (complicated math formulas) off the blackboard, and then left the room. After the game, the experimenter looked at the blackboard and then noticed that the information had been wiped off. She then asked the participant whether he/she saw someone wiping off the information. All participants in the truthful condition told the experimenter that the person who came in during the game wiped the information off the blackboard. Then, the experimenter gave the

following instructions: "Actually, I know that the information should not have been wiped off the blackboard, as it is needed for a lesson later on. In a minute you will be interviewed by another woman. Her task is to find out who wiped the information off the blackboard. Now, you know you did see who it was, so your task is to convince her that you did. All you need to do is be truthful about everything that happened while you were in this room. So say that we played a game of Connect 4 and that someone came in to wipe the blackboard. This is very important as, if you are successful in convincing her that you are telling the truth, we will give you (undergraduates - £5; 14-15-year-olds - £2; 11-12-year-olds - £2; 6-8-year-olds - a present). At the end of the interview, she will tell you whether she believes you or not. If she does believe that we played Connect 4 and that someone came in to wipe the blackboard, we will give you the money/present when you come out. If she doesn't believe you, you will not get any money/present at all. Do you understand?"¹

Participants in the fabricating condition ($N = 94$) were told by the experimenter that she (the experimenter) earlier wiped some important information off the blackboard which was supposed to stay on there for a lesson later on. The participants were told that he/she would be interviewed by another woman whose task was to find out who wiped the information off the blackboard. The experimenter then asked the participants to pretend that it wasn't the experimenter who wiped the information off the blackboard. Instead the participants were asked to pretend that they (experimenter and participant) played Connect 4 and that someone else entered the room and wiped off the information during the game. Identical to the truthful witness condition, it was stressed that if the participant was successful in convincing the interviewer that it was someone else who wiped the information off the blackboard, he/she would receive £5/£2/present, and that he/she would receive nothing at all if the interviewer did not believe him/her. Again, participants were informed that the interviewer would tell the participants at the end of the interview whether or not she believed them.²

All participants were then randomly allocated to either the light coaching condition or the heavy coaching condition. Participants in the light coaching condition ($N = 91$) were told that it is important that the interviewer believes that the experimenter and participant played Connect 4 and that someone came in who wiped the information off the blackboard. It was further stressed that it is more likely that the interviewer would believe the participant if he/she told in lots of detail, what happened when he/she was in the room. For example, just saying: "Well, it was a bit boring really!" wouldn't convince the interviewer.

In addition to these light coaching instructions, participants in the heavy coaching conditions ($N = 89$) were given further information. The information differed for liars and truth tellers. Fabricating participants (except 6-8-year-olds) were given the following verbal instructions: "Here are some more things to think about when you are in the interview. Our research shows that these things help people to believe what you are saying: (a written version of these verbal instructions was put in front of the participants as well)

- (1) try to include as many details as you can. For example, include some details about your "pretend" person. Was it a man or a lady? What was he/she wearing? (This is CBCA criterion 3).
- (2) Describe "interactions", that is, describe how you think you would have reacted when we were playing the game or when the person interrupted us. For example, "I think (name of the experimenter) was a bit annoyed when I won the game" (CBCA criterion 5).
- (3) Try to describe what people said to each other. For example, if someone had come into the room, what do you think he/she would have said to us? What do you think we would have said to one another when we were playing the game? (CBCA criterion 6).
- (4) Pretend that something unusual or unexpected happened. For example, pretend that you dropped some of your discs for the game on the floor. (CBCA criterion 7).
- (5) Describe how you felt when you were in the room. For example, if someone had interrupted our game, how do you think you would have felt? (CBCA criterion 12).

(6) Try to include how you think the person who wiped the blackboard was feeling."

Participants were then asked to think about the story they were going to tell in the subsequent interview. When they said they were ready to be interviewed, they were asked to practice the story with the experimenter first. The experimenter listened to the participants' story and checked whether the participant included all six criteria. If not, questions about these criteria were asked (i.e. "Could you think of something that the person who came in the room might have said to us?"). The interviewee was then encouraged to include this piece of information in their account as well. Finally, information about two more criteria (Criteria 14 and 15) were given:

(7) "The interviewer won't expect you to remember everything, because we can't always remember everything. If you don't remember something, tell the interviewer that you can't remember. Also, the interviewer will be more likely to believe you if you have forgotten some of the little things she asks you about. So it will be a good idea to tell her you have forgotten when she asks you. (CBCA criterion 15).

(8) Feel free to correct yourself if you think you have made a mistake, if you have contradicted yourself or something." (CBCA criterion 14).

The coaching for 6-8-year-olds was slightly different. They were only taught criteria 3, 5 and 6, and the training was conducted in a more interactive manner (i.e. "Pretend a woman came in: What was she wearing?" (child gives an answer); "What was the color of her hair?" (child gives an answer), etc.. The child was then encouraged to include the answers they had given in their upcoming interviews.

The heavy coaching condition for truthful participants was very similar to the heavy coaching condition just discussed. Obviously, they were not asked to pretend something but were simply asked to describe the actual event, i.e. were asked to describe what the person who wiped the blackboard was wearing, were asked to mention exactly what was said while the participant was in the room, etc..

After the coaching instructions were completed and after the participants had practiced their stories with the experimenter, the participant was brought to the (female) interviewer who was in another room. The interviewer was unaware of the condition the participant was in, except from the witness/suspect status of the participants (see endnote 2). (The interviewer needed to know the status of the participants as the instructions she had to give to suspects and witnesses differed). After building rapport with the participant, the interviewer gave participants in the witness condition the following instructions: "The reason I am interviewing you is that I have heard that someone wiped some important information off the blackboard in the room you were just in. I understand that you were in there just now with (name of experimenter). I need to know if you saw anything that will help me to find out who it was.³ Also, remember that my colleagues need to know whether I think you are telling the truth or not. I would like you to tell me, in as much detail as possible, everything you can remember about what happened when you were in that room just now. Give me as much information as you can, even small details you do not think are very important".

After this free recall the interviewer told each participant that they had convinced her (the interviewer) that they told the truth and that they would receive the money/present. (For ethical reasons the interviewer was instructed to tell all children that she believed them, regardless of how convincing their stories were). With regard to the undergraduates, she was instructed not to give money to participants who gave very short statements. However, all undergraduates did put effort in giving extensive and credible statements, and all were paid £5. Outside, the participants received their money/present, were debriefed and thanked.

Questionnaire, CBCA Scoring, and Reality Monitoring scoring

Social anxiety was measured with Fenigstein, Scheier, and Buss' (1975) social anxiety scale (5 items). The questions for the 6-8-year-olds (which were answered by their parents) were written in a third person format. For example, the item "I get embarrassed very easily" (which was used for the 11-12-year-olds, 14-15-year-olds, and undergraduates) was

rephrased to: "The child gets embarrassed very easily"). Answers could be given on answer scales ranging from (1) untrue to (4) true (Cronbach's alphas were .86 (6-8-year-olds) and .77 (11-12-, 14-15-year-olds and undergraduates)). Social adroitness was measured with Jackson's (1978) social adroitness scale (20 items). Again, the child questions were written in a third person format (Cronbach's alphas were .77 (6-8-year-olds) and .76 (11-12-, 14-15-year-olds and undergraduates)). Self-monitoring was measured with Briggs, Cheeck, and Buss' (1980) self monitoring scale (21 items). Again, the child questions were written in a third person format (Cronbach's alphas were .70 (5-6-year-olds) and .63 (11-12-, 14-15-year-olds and undergraduates)). Pearson correlations revealed that self monitoring and social adroitness ($r(177) = .41, p < .01$) and self monitoring and social anxiety ($r(177) = -.45, p < .01$) were significantly correlated, whereas social adroitness and social anxiety ($r(177) = -.12, ns$) were not.

Two independent raters received training in CBCA scoring. First, both raters read several major published papers about CBCA (Raskin & Esplin, 1991; Steller, 1989; Steller & Köhnken, 1989; Vrij, 2000; Vrij & Akehurst, 1998). Second, they were trained in CBCA scoring by a British CBCA expert. The expert explained each criterion under investigation in this study (see below) and gave examples of each criterion. Third, both the trainee raters and the expert rater evaluated one example transcript individually (from a different study). The three raters compared their results and feedback was given by the expert rater. Fourth, the trainees received more transcripts and were asked to rate these transcripts at home. In a follow up meeting, the results were evaluated and, again, feedback was given by the expert. After that meeting the expert felt that at that time the two raters had obtained sufficient rating skills and it was decided that the raters could commence their coding task for the present experiment. Coding was carried out individually by the two trained coders only (they coded the statements at home) and took place on the basis of the written transcripts of the interviews. The raters were blind to the hypotheses under investigation, to the staged event,

and to the experimental conditions the participants were allocated to (although they were aware that some transcripts would be truthful and some not). Some criteria ("accurately reported details misunderstood" (criterion 10); "pardoning the perpetrator" (criterion 18) and "details characteristic of the offense" (criterion 19)) were not scored, as they are specifically related to (sexual) crimes. "Self deprecations" (criterion 17) was initially to be scored but was never in fact present. This criterion was therefore disregarded, leaving a total of 15 CBCA criteria to be assessed. The coders scored the strength of presence of criteria 1 and 2 in each statement on 5-point Likert scales ((1) = absent, (5) is strongly present), and scored the frequency of occurrence of the other criteria in each statement. We then calculated a total CBCA score. This has been done before not only in experimental laboratory research (Tye et al., 1999; Vrij et al., 2000, 2001a, b, 2002, in press; Winkel & Vrij, 1995) but also in real life situations (Craig, Scheibe, Raskin, Kircher, & Dodd, 1999; Hershkowitz, Lamb, Sternberg, & Esplin, 1997; Lamb et al., 1997a, b; Parker & Brown, 2000). In order to create the CBCA scale the criteria were dichotomized. Dichotomizations for criteria 4 to 16 were based on the absence or presence of each of the criteria in the interview. A score of 0 was assigned when the criterion was absent, and a score of 1 when the criterion was present. For criteria 1 and 2, a 0 was assigned when the criterion obtained a "1" rating on the 5-point Likert scale, and a 1 was assigned when the criterion obtained a score of 2, 3, 4, or 5 on the 5-point Likert scale. For dichotomization of criterion 3, median splits were used.⁴ Total CBCA scores were calculated for both coders. The correlation between these two CBCA scores was moderate but acceptable (.66). In the present analyses we used as total CBCA score the average score of the two coders. The score could range from 0 to 15.⁵

Two other raters received training in Reality Monitoring (RM) scoring. A British RM expert (different from the CBCA expert) provided the raters with a detailed description of how the criteria should be scored, including some case examples. Then, both the trainee raters and the expert evaluated some example transcripts individually (from a different

study). The three raters compared their results and feedback was given by the expert. At this stage the expert and the two raters felt that the raters were capable of scoring the transcripts without any further instructions. This is in agreement with Sporer (1997) who also found that it is much easier to teach (and to learn) RM scoring than CBCA scoring. With regard to the present study, coding was carried out individually by the two trained raters (they coded the statements at home) and involved the written transcripts of the interviews. The raters were blind to the hypotheses under investigation, to the staged event, and to the experimental condition (although they were aware that some transcripts would be truthful and some not). The two raters scored per interview the frequency of occurrence of visual details (e.g., "I walked in to the room" contains three visual details), auditory details (e.g., "She said to sit down" contains one sound detail), temporal details (e.g., "We started playing" is one temporal detail), spatial details (e.g., "And then the pieces fell on to the floor" contains one spatial detail) and cognitive operations (e.g., "Because she was quite clever, she won the game" contains one cognitive operation; so do "I presume that the two people knew each other" and "She was quite tall for a girl"). Following previous examples (Vrij et al., 2000, 2001b, in press) a total Reality Monitoring score was calculated. In order to create the Reality Monitoring scale the visual, auditory, spatial and temporal variables were dichotomized (see also Vrij et al., 2000, 2001b, in press). Dichotomizations for auditory, temporal and spatial details were based on the absence or presence of each of the criteria in the interview. A score of 0 was assigned when the criterion was absent, and a score of 1 when the criterion was present. Cognitive operations were dichotomized as well, with a score of '1' given if no cognitive operations were present and a score of '0' when cognitive operations were present. For dichotomization of visual details, median splits were used. For reasons explained in the CBCA scoring paragraph (see above), different median splits were used for 6-8-year-olds and the other participants. Total Reality Monitoring scores were calculated for both coders. The correlation between these two Reality Monitoring scores was satisfactory (.71). In the present

analyses we used as total Reality Monitoring score the average score of the two coders.⁶ The Reality Monitoring scale contained five criteria (visual details, auditory details, spatial details, temporal details and cognitive operations) and the total-score could range from 0 to 5.⁷

Results

CBCA Scores and Reality Monitoring Scores as a Function of Truth-status, Age, and Coaching

In order to test Hypotheses 1 to 5, a MANOVA was conducted with Truth-status (truth vs lie), Age (6-8, 11-12, 14-15, undergraduates) and Coaching (light vs heavy) as factors and CBCA score, and Reality Monitoring score as dependent variables. At a multivariate level, the analysis revealed main effects for all three factors, Truth-status, $E(2, 163) = 23.62, p < .01$, Age, $E(6, 324) = 8.84, p < .01$, and Coaching, $E(2, 163) = 6.26, p < .01$. None of the interaction effects were significant.⁸

At a univariate level, the Truth-status factor revealed significant findings for both dependent variables. In support of Hypotheses 1 and 4, truth-tellers obtained higher CBCA scores ($M = 6.73, SD = 1.5$) than liars ($M = 6.19, SD = 1.7$), $E(1, 164) = 6.24, p < .01$, and truth-tellers obtained higher Reality Monitoring scores ($M = 3.77, SD = .8$) than liars ($M = 2.79, SD = 1.0$), $E(1, 164) = 47.49, p < .01$.

Regarding the Age factor, univariate tests revealed significant findings for CBCA scores, $E(3, 164) = 17.18, p < .01$. The linear trend, predicted in Hypothesis 2, emerged (see Table 1). The older the participants, the higher their CBCA scores. The CBCA scores for 14-15-year-olds and undergraduates were significantly higher than the CBCA scores for 6-8-year-olds; 11-12-year-olds obtained significantly lower CBCA scores than undergraduates. The CBCA scores for 6-8- and 11-12-year-olds did not differ significantly from each other, neither did the CBCA scores for 14-15-year-olds and undergraduates. Univariate tests revealed a significant effect for Reality Monitoring score as well, $E(3, 164) = 3.35, p < .05$.

However, Tukey HSD tests did not reveal differences between the four age groups. One could argue that this is caused by the inclusion of cognitive operations in the Reality Monitoring score, as there is no reason to assume that younger children would include more cognitive operations in their statements than older children or undergraduates (this is necessary to obtain a higher Reality Monitoring score). We therefore excluded cognitive operations from the total Reality Monitoring score for this analysis (the new total Reality Monitoring score consisted of four dependent variables: visual, auditory, spatial and temporal details). We conducted Tukey HSD tests on this newly constructed Reality Monitoring score and the findings are shown in Table 1. The pattern which emerged is very similar to the CBCA pattern just described, and supports Hypothesis 5.

Regarding the Coaching factor, univariate tests revealed one significant effect. As was predicted in Hypothesis 3, heavily coached participants obtained higher CBCA scores ($M = 6.79$, $SD = 1.7$) than lightly coached participants ($M = 6.12$, $SD = 1.5$), $E(1, 164) = 10.89$, $p < .01$.

Of theoretical interest are the Truth-status X Coaching and Coaching X Age interaction effects. Although the Truth-status X Coaching effect regarding CBCA scores was not significant, $E(1, 164) = .82$, *ns*, an interesting pattern emerged. The difference between truth tellers and liars was not significant for the heavily coached participants, $E(1, 87) = .82$, *ns*, but was significant for the lightly coached participants, $E(1, 89) = 5.41$, $p < .05$. In the lightly coached condition truth tellers obtained a higher CBCA score ($M = 6.50$, $SD = 1.4$) than liars ($M = 5.80$, $SD = 1.4$).

The Truth-status X Coaching interaction effect was significant for Reality Monitoring scores, $E(1, 164) = 5.02$, $p < .05$. In the heavily coached condition, truth tellers obtained a higher Reality Monitoring score ($M = 3.60$, $SD = .9$) than liars ($M = 2.95$, $SD = .9$, $E(1, 87) = 11.38$, $p < .02$). The same pattern emerged in the lightly coached condition, $E(1, 89) = 46.86$, $p < .01$, with truth tellers obtaining higher Reality Monitoring scores ($M = 3.95$, $SD = .7$)

than liars ($M = 2.65$, $SD = 1.0$). The differences between liars and truth tellers were larger in the lightly coached than in the heavily coached condition.

Although the Coaching X Age interaction effect regarding CBCA scores and Reality Monitoring scores was not significant, $E(3, 164) = 1.35$, *ns* and $E(3, 164) = .31$, *ns* respectively, examining the results per age group is relevant, particularly for the CBCA scores. The results are presented in Table 2. The results for the 6-8-year-olds showed that coaching was not successful. CBCA scores for heavily coached and lightly coached participants were almost identical and did not differ significantly from each other. For the three remaining groups, however, the CBCA scores were significantly higher for heavily coached participants than for lightly coached participants.

CBCA Scores, Reality Monitoring Scores and Social Skills

In order to test Hypothesis 6, Pearson correlations were carried out between CBCA scores and Reality Monitoring scores on the one hand and social anxiety, social adroitness, and self monitoring on the other hand. The results are shown in Table 3.

As was predicted in Hypothesis 6, CBCA scores were positively correlated with social adroitness and self monitoring scores and negatively correlated with social anxiety scores. All three correlations were significant. Regarding Reality Monitoring scores one significant finding emerged. Reality Monitoring scores were negatively correlated with social anxiety. A distinction between liars and truth tellers (see Table 3) revealed that the correlation patterns, just described, particularly occurred when participants were lying.⁹

CBCA Scores and Reality Monitoring scores: Their Discriminative Power

In order to determine the usefulness of the detection techniques in classifying truth tellers and liars, stepwise discriminant analyses utilizing the Wilks' Lambda method were conducted. With this technique the variables remaining in the final analysis are those which contribute to maximizing the correct assignment of the cases to the objective truth status. In the analyses, the objective truth status was the classifying variable and the CBCA score, and

Reality Monitoring score were the dependent variables. In order to examine whether CBCA classifications would benefit from a 'lie criterion', the original, non-dichotomized, cognitive operations variable was introduced as a dependent variable as well. Because coaching had an impact on the dependent variables, analyses were carried out for the lightly coached participants only. The results are given in Table 4.

As can be seen in Table 4, 60% of the cases could be correctly classified on the basis of the CBCA scores alone, whereas 74% could be correctly classified on the basis of the Reality Monitoring alone. The analysis which included CBCA scores plus cognitive operations revealed that 74% of the cases could be correctly classified on the basis of these two variables (both cognitive operations, Wilks' Lambda = .83, and CBCA score, Wilks' Lambda = .71, contributed to the discriminant function). Finally, the analysis in which CBCA and Reality Monitoring scores were included showed that only Reality Monitoring contributed significantly to the discriminant function.¹⁰

Discussion

The experiment revealed that truth tellers obtained higher CBCA scores and Reality Monitoring scores than liars. There is now a substantive number of studies showing that CBCA scores and Reality Monitoring scores do discriminate between liars and truth tellers (see Vrij (2000) for reviews). The finding regarding cognitive operations (presented in endnote 8) is more exceptional. We have now demonstrated for the second time that, conforming to predictions, liars, compared to truth tellers, include more cognitive operations in their account when they describe a life-event (rather than recalling a film they have seen). The discriminant analyses revealed that liars and truth tellers were more accurately classified on the basis of their Reality Monitoring scores than on the basis of their CBCA scores. These findings support those who claim that Reality Monitoring could be used as an alternative tool of verbal lie detection. As mentioned in the Introduction, one of the advantages of Reality Monitoring is that the method also contains a lie criterion (cognitive operations). The CBCA

technique (which only scores for truth) might become more balanced and might result in higher accuracy when lie telling criteria (criteria which indicate deception) are included. The present findings support this assumption. A discriminant analysis which included the CBCA scores and cognitive operations as dependent variables resulted in a higher hit rate (74%) than the discriminant analysis with CBCA scores alone (60%). Also Vrij et al. (in press) found that accuracy improved when cognitive operations was included as an additional variable alongside CBCA. The analyses further revealed that more accurate classifications of liars and truth tellers were made if the cognitive operations variable was removed from the total Reality Monitoring scale and was introduced as a separate variable alongside this new Reality Monitoring scale which did not contain cognitive operations (see endnote 10). This is likely due to the fact that the cognitive operations variable is conceptually different from the other criteria: its presence does not indicate truth telling (as is the case with the other criteria), but lying. **Treating the two sets of variables as distinctive sets of variables could therefore be recommended.**

A second aim of the experiment was to examine whether participants could improve their CBCA scores when they were given insight into the CBCA criteria. The findings revealed that coaching indeed improved participants' CBCA scores, however, not for the youngest group of participants (6-8-year-olds). This will please those who support the use of CBCA assessments regarding young children being used as evidence in criminal court. However, our findings do not suggest that teaching young children to improve their CBCA scores is impossible. The "training" was short (it lasted less than ten minutes) and perhaps young participants would benefit from a more extensive training session. However, we do believe that our findings suggest that training young children to improve their CBCA scores is difficult.

Our final aim was to investigate to what extent CBCA scores are influenced by participants' social skills. The same findings emerged as in our previous study (Vrij et al.,

2002). CBCA scores were positively correlated with social adroitness and self monitoring and negatively correlated with social anxiety. These findings also emerged when we controlled for the effects of the coaching manipulation and age of the participants. On the basis of these two studies, we therefore recommend SVA evaluators to take people's social skills into account when they evaluate CBCA scores. This relationship between social skills and CBCA scores was clearer in lying participants than in those who were telling the truth. The same pattern emerged in Vrij et al.'s (2002) study. Perhaps this has to do with the difficulty of the task. It seems plausible to suggest that the task was more difficult for liars than for truth tellers. Perhaps a task needs to be verbally challenging in order for these social skills focusing on verbal skills to discriminate.

The inter-rater agreements between the two coders regarding the individual CBCA criteria were (i) sometimes low and (ii) mostly lower than their inter-rater agreement regarding the total CBCA scale. These patterns are consistent with findings in previous CBCA research (see Vrij, in press, for a discussion about these issues). It implies that, at least on reliability grounds, experts involved in real-life cases should use the total CBCA scale rather than relying on individual CBCA criteria. Although we are not aware of CBCA experts who merely focus on individual criteria in real life cases, we cannot rule out that experts who do not officially use the CBCA method but who are familiar with its content would do so.

Finally, five issues merit attention. First, different age groups received different rewards, therefore effects of age were confounded with type of motivation. We varied the reward so as to avoid such a confound. We believe that giving all participants the same reward would have created a confound because the same reward (for example £5) would be perceived as substantially higher by young children than by undergraduates. However, it is difficult to determine what would be comparable rewards for different age groups. With hindsight, we could have asked participants this. Second, the coaching manipulation for the 6-8-year-olds differed somewhat from the coaching manipulation of the other groups of

participants. Although this created a confound in experimental terms, we had no other choice. In a previous study (Vrij et al., 2002), we exposed young children to the heavy coaching condition we used for older participants in this study but had to cancel this condition as some children clearly did not understand the instructions. Third, we did not include a non-coaching condition in our experimental design. We did so for ecological validity reasons. In experimental studies participants are probably less motivated to make a convincing impression than in real life situations. We were therefore afraid that not providing any guidance to our participants might have resulted in poor quality statements. Obviously, comparing a heavy coaching condition with a no coaching condition would have made significant findings more likely, but even in the present study, where we compared heavy coaching with light coaching, we found the predicted coaching effects on CBCA scores. Fourth, following our previous study (Vrij et al., 2000), the parents rather than the children themselves completed the social skills questionnaires in the 6-8-year-old age group. Asking such young children to complete the questionnaires themselves was impossible for obvious reasons. We have no reasons to believe that the results were affected by this possible shortcoming. For example, the predicted relationships between social skills and CBCA scores occurred even when the impact of 'age' was partialled out. Also, the parents were blind to the hypotheses under investigation. Fifth, some sceptics will argue that the outcomes of this study say little about SVA assessments in the field, as we only focused on CBCA and not on the whole lengthy SVA procedure. They will say that CBCA should not be assessed independent of the other components of the procedure. We disagree with those sceptics for several reasons. First, although CBCA is only part of the SVA procedure it is the core part of that procedure. Clearly, the outcome of SVA assessments should be received with high scepticism if the core of the procedure (CBCA) is found not to discriminate between truth tellers and fabricators. Second, a qualitative review of the application of statement analyses in Swedish courts (one of the countries where SVA originated) showed that experts rely

heavily on the CBCA outcomes (Gumpert & Lindblad, 2001). That is, although they sometimes acknowledge that several external factors (typically those factors covered in the Validity Checklist) might have affected a CBCA outcome, they never came to the conclusion that these factors could solely explain the CBCA scores and therefore high-quality statements (which result in high scores) were generally interpreted as referring to self-experienced events.

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Table 1

CBCA scores and Reality Monitoring scores as a Function of Age (N = 180)

| | Age | | | | | | | | 6-8 |
|-----------------|--------------------|-----|--------------------|-----|-------------------|-----|-------------------|-------------------|-----|
| | | | | | | | | | |
| | 11-12 | | 14-15 | | undergraduates | | | | |
| | m | sd | m | sd | m | sd | m | sd | |
| | CBCA | | | | | | | 5.30 ^a | |
| | 6.23 ^{ab} | 1.6 | 6.75 ^{bc} | 1.6 | 7.25 ^c | 1.5 | | | |
| RM ³ | 2.22 ^a | 1.1 | 2.56 ^a | .9 | 3.05 ^b | .7 | 3.09 ^b | .9 | |

³ The total Reality Monitoring score consisted of four variables: visual, auditory, temporal and spatial details.

Table 2

CBCA scores as a function of Coaching and Age

| CBCA scores | Coaching | | | |
|----------------|----------|-----|-------|-----------------------------------|
| | light | | heavy | |
| | m | sd | m | sd |
| 6-8 | 5.29 | 1.0 | 5.31 | 1.1 F(1, 42) = .00 |
| 11-12 | 5.63 | 1.3 | 6.94 | 1.7 F(1, 33) = 6.49* |
| 14-15 | 6.36 | 1.4 | 7.13 | 1.7 F(1, 42) = 2.77* ⁴ |
| undergraduates | 6.86 | 1.5 | 7.64 | 1.4 F(1, 55) = 3.87* |

* $p < .05$

Table 3

Pearson Correlations between CBCA score, Reality Monitoring score, and Social Anxiety-, Social Adroitness-, and Self Monitoring Scores

| Total group (N = 177) | | | |
|------------------------|----------------|-------------------|-----------------|
| | Social Anxiety | Social Adroitness | Self Monitoring |
| CBCA | -.25** | .23** | .24** |
| RM | -.23** | -.03 | .03 |
| Liars (N = 92) | | | |
| | Social Anxiety | Social Adroitness | Self Monitoring |
| CBCA | -.39** | .29** | .26* |
| RM | -.28** | .13 | .09 |
| Truth tellers (N = 85) | | | |
| | Social Anxiety | Social Adroitness | Self Monitoring |
| CBCA | -.02 | .21 ⁵ | .26* |
| RM | -.05 | -.11 | .08 |

* $p < .05$ ** $p < .01$

⁵ $p = .056$ (two-tailed)

Table 4.
Discriminant Analyses with Criteria-Based Content Analysis, Reality Monitoring and Cognitive Operations:
Lightly coached participants only (N = 91).

| Detection technique | hit rates | | total | Eigenvalue | Lambda | df | X2 | |
|---------------------|-----------|-------|-------|------------|--------|------|-----------------------|-----|
| | lie | truth | | | | | CBCA | 69% |
| | 50% | 60% | .06 | .94 | 1 | 5.41 | | |
| RM | 61% | 88% | 74% | .52 | .65 | 1 | 37.43 | |
| CBCA + co | 74% | 74% | 74% | .41 | .71 | 2 | 30.09 | |
| CBCA + RM | 61% | 88% | 74% | .52 | .65 | 1 | 37.43 | |
| | | | | | | | * p < .05, ** p < .01 | |

Coaching and Deception

1. It might seem suspicious from the participant's perspective that the experimenter would know that an interview was about to ensue in order to ascertain the truth of the blackboard mishap. We had prepared an answer which the experimenter would give in case a participant asked a question about this. However, none of the participants in this study raised this issue. In other words, we have no evidence that the participants were suspicious.
Telling the participants at the end of the interview whether or not the interviewer believed the participants reflects police practice: such statements sometimes occur at the end of suspect and witness interviews.
2. The truthful and deceptive conditions described are the witness conditions. Similar to Vrij et al. (2002) we also introduced suspect conditions for the three oldest groups of participants. The truthful suspect condition was similar to the truthful witness condition, but this time participants were accused of having wiped the information off the blackboard themselves. In the deceptive suspect condition, participants had wiped off the blackboard themselves and were accused of having done so in the subsequent interview. In addition to the promised gift if they succeeded in telling a convincing story, truthful and deceptive suspects also faced a punishment if they were not convincing, they were be asked to write down in detail what has happened. This suspect/witness manipulation did not yield a significant effect and is disregarded in this article. See Vrij et al. (2002) for a theoretical rationale for this manipulation.
3. The interviewer gave participants in the suspect condition the following instructions: "The reason I am interviewing you is that I have heard that YOU wiped some important information off the blackboard in the room you were just in. I understand that you were in there just now with (name of the experimenter). I need to know whether it was you or not!" For the remaining part, the suspect interviews and instructions were identical to the witness interviews and instructions.
4. Separate median splits were used for (i) 6-8-year-olds and (ii) for the remaining participants for the following reason: An ANOVA with Age Group as factor and details as dependent variable (scores of 2 coders combined) revealed a significant effect, $E(3, 176) = 18.28, p < .01$. Tukey HSD tests revealed that 6-8-year olds included significantly fewer details in their statements ($M = 14.75, SD = 5.8$) than any of the other three groups (10-11-year-olds: $M = 21.69, SD = 8.3$; 14-15-year-olds: $M = 24.80, SD = 8.2$; undergraduates: $M = 26.99, SD = 10.6$). These three groups did not differ significantly from each other. A median split for the whole group would therefore imply that almost all 6-8-year-olds would be allocated to the "low score" group and many other participants to the "high score" group (as the median split would be relatively low).
5. Inter-rater agreement were also calculated for the individual criteria on the original, non-dichotomized, scores. Several (Pearson) correlations were high: reproduction of conversation ($r = .83$), quantity of details ($r = .76$), and admitting lack of memory ($r = .74$); others were moderate: raising doubt about one's own testimony ($r = .58$), description of interactions ($r = .52$), contextual embeddings ($r = .51$), accounts of own mental state ($r = .45$), superfluous details ($r = .44$), accounts of other's mental state ($r = .42$); others were rather low but significant: unexpected complications ($r = .35$), spontaneous corrections ($r = .35$), and logical structure ($r = .34$). The remaining correlations were not significant: unstructured production ($r = .20$), related external associations ($r = .11$), and unusual details ($r = .09$). The latter two criteria were hardly present, and appeared in less than 8% of the statements. Previously (Vrij et al., 2002), we left out the criteria with low reliability before computing a total CBCA score. However, this does not reflect real-life practice where CBCA experts typically rely on all the criteria they assess. We therefore included all 15 criteria in the total CBCA score, and the correlation between the total CBCA scores of both judges (.66) justified this. We return to this issue in the Discussion.
6. Inter-rater agreements were also calculated for the five individual criteria. All Pearson correlations were satisfactory: auditory details ($r = .96$), temporal details ($r = .87$), visual details ($r = .76$), spatial details ($r = .68$) and cognitive operations ($r = .61$).
7. All truthful participants participated in more or less the same staged event. It might therefore be that the truths told by these participants bore certain similarities. These similarities could be picked up by the CBCA and Reality Monitoring raters after a few trials of coding, and this "knowledge" might have affected their codings. We do not think that this actually happened.

Coaching and Deception

Although there were similarities in the staged event, there were also differences which were purposefully introduced by us in order to prevent this happening. For example, different people were used to come into the room and wipe the blackboard. Also, the same person wore different clothes at different times. As a result, the descriptions of the "actor" differed considerably even in the truthful condition. (Because variations of the same staged event were introduced, we videotaped all participants while they were in the room with the experimenter, and checked the veracity of their stories afterwards by comparing their statements with what actually had happened. We did not come across any commissions, purposefully distorting the truth, in the truthful reports). Additionally, not all truthful participants gave a complete account, with some participants describing some features and other participants describing totally different features.

8. For reasons pointed out in the Introduction, we were also interested in the results for the cognitive operations variable separately. An ANOVA was conducted with Truth-status, Age and Coaching as factors and cognitive operations (the original, not dichotomized scores) as dependent variable. The analysis revealed main effects for Truth-status, $E(1, 164) = 38.56, p < .01$, and Age, $E(3, 164) = 7.18, p < .01$, and a Truth-Status X Age interaction effect, $E(3, 164) = 3.88, p < .05$. The interaction revealed that liars included significantly more cognitive operations in their accounts than truth tellers in all age groups except in the youngest age group (6-8-year-olds: $M = .41, SD = .9$ vs $M = .10, SD = .3, E(1, 42) = 2.37, ns$; 11-12-year-olds: $M = .56, SD = .5$ vs $M = .22, SD = .4, E(1, 33) = 4.99, p < .05$; 14-15-year-olds: $M = 1.17, SD = 1.1$ vs $M = .40, SD = .6, E(1, 42) = 8.12, p < .01$; undergraduates: $M = 1.55, SD = 1.3$ vs $M = .24, SD = .4, E(1, 55) = 26.09, p < .01$). Tukey HSD tests regarding the Age main effect revealed that 6-8-year-olds included fewer cognitive operations in their accounts ($M = .26, SD = .7$) than the other age groups which did not differ significantly from each other (11-12-year-olds: $M = .39, SD = .5$; 14-15-year-olds: $M = .82, SD = 1.0$; undergraduates: $M = .93, SD = 1.2$).
9. Partial correlations controlling for (i) the coaching manipulation and (ii) age of the participant revealed the same significant effects as the effects presented in Table 3, suggesting that age and coaching have no moderated impact on the relationships between social skills and CBCA and Reality Monitoring scores.
10. In subsequent analyses, we separated cognitive operations from the Reality Monitoring scale (leaving the Reality Monitoring scale with four variables: visual, auditory, temporal and spatial details) and included the new Reality Monitoring scale and cognitive operations (original, non-dichotomized scale) as two separate dependent variables in the discriminant analysis. This analysis yielded higher accuracy rates than the accuracy rates presented in Table 4 (lie: 76%, truth: 88%, total 81%) and both Reality Monitoring scores (Wilks' Lambda = .82 and cognitive operations, Wilks' lambda = .56, contributed significantly to the discriminant function). A discriminant analysis with total CBCA score, total (new) Reality Monitoring score and cognitive operations as dependent variables gave high accuracy rates too (lie: 76%, truth: 93%, total: 84%). All three variables contributed to the discriminant function (Reality Monitoring score, Wilks' Lambda = .82, cognitive operations, Wilks' Lambda = .56, CBCA score, Wilks' Lambda = .55).

Analyses per age group are available from the first author.